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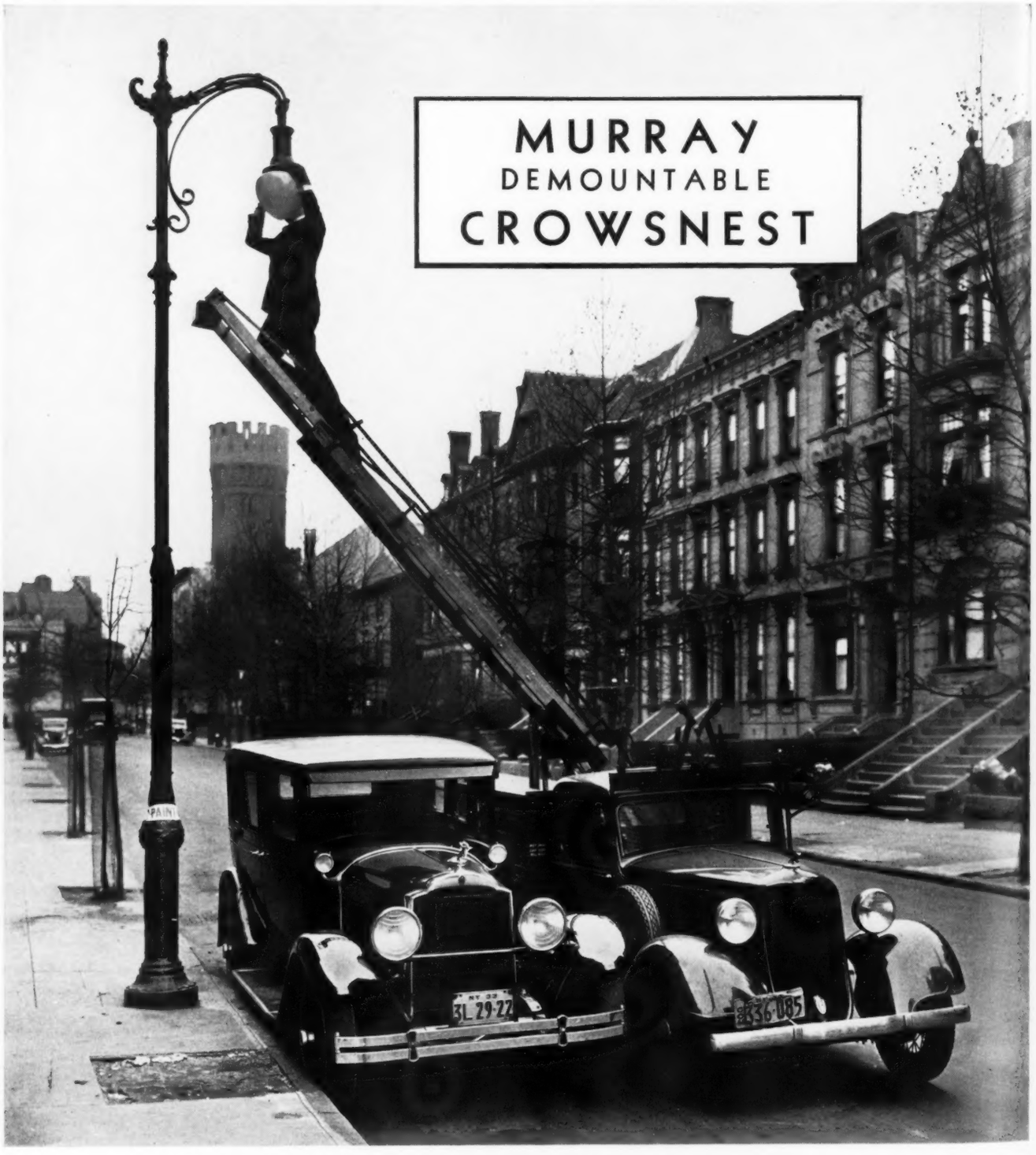

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What in the World!

The government is spending about $300,000,000 a month in payrolls. We notice the automobile industry is hard after these consumer dollars. What is the matter with the sales activities of the electrical industry? See our editorial.

●

Congress is busy with the St. Lawrence treaty fight. Despite an absence of opposition from the power industry, it is being brought into the debates as the "sinister power trust" that would destroy a national development. It is high time for certain Senators to get hold of some new phrases.

●

All our editors have gone to the field again to find out what the industry is doing and planning. Current reports are quite encouraging. That "victorious attitude" is all that is needed to bring reasonable prosperity and contentment of mind.

●

Washington is trying to digest a mess of electrical codes. Watch our correspondents in our news each week to find out what progress is being made and what appears to be the outcome. In the meantime we are trying to find out how the codes are working in their practical applications. So far, not so well.

●

One effect of the money moves has been to revive the stock market. Even utility securities feel an impetus and prevalent investment advice is to accumulate good utility securities in expectation of a bull market for the next three months. Both ligitimate and artificial stimuli exist for an increase in security prices. But the market must go far to recoup the losses of some of us who counted paper profits in the old days.

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February 10, 1934

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February 10, 1934

L. W. W. MORROW, *Editor*

Federal-Spending Compels Utility-Selling

WASHINGTON is now paying out about $400,000,000 each month on relief and recovery projects. And whether it goes to public works, housing, T.V.A. or farmers, it is all cash money that buys either labor or materials. It winds up in the pockets of men and women. It is being spent for food and clothes and whatever else American families want in times like these.

Immediately, then, the people who sell them these things spend it again, and this $400,000,000 a month turns over—six times, ten times—what you will. Therefore it eventually becomes many billions of dollars, ready in the market-place every four weeks. This will continue for at least six months. On top of the backlog of regular business, it makes a vast volume of extra money in the home, that is now rolling out mainly to merchants, middle men and manufacturers.

The alert market-minded automobile industry is after this money and getting it. Ask the incandescent lamp men how the sale of headlight bulbs has jumped. But what is the power industry doing about it? What share of this family spending are the manufacturers of household electric appliances going to make their own?

The power industry stands appalled today because the public is demanding lower rates at the same time that the politicians are raising taxes and building competing federal power systems. Yet there is only one way out of the dilemma. Domestic load must be increased to the point where it will carry lower rates. And if the rate comes first, that makes the selling easier.

The present situation, therefore, offers to the power companies enormous possibilities for progress with their difficult problem. The lower rates are coming. It is written on the wall. Larger consumption from the home will turn to profit those many million small consumers now carried at a loss. More and better selling will increase the average domestic load. That will justify the rate. Now is the time to sell and to make the reduction.

Some people think that relief money makes no market for electrical appliances. True, the man who receives his check from C.W.A. or C.C.C. may not himself be a prospect. He spends his pittance at the grocery store or for a pair of shoes. But the wholesale grocer and the shoe manufacturer and the concrete mixer maker and their employees soon get these dollars and before long somebody takes them home. Then he and his wife spend them. And they spend them for the things that modern families want. And families will want electrical appliances if we do a selling job. And right now they can buy them with this new money in our market.

It needs no miracle to find the way out for the light and power industry. It needs just selling—backed by imagination, zeal and courage

to risk the same kind of hazards that men in competitive business must habitually face. To build this load electric ranges, water heaters, refrigerators and other appliances must be sold in great numbers by all the forces of the electrical industry. If they are sold, the utilities can meet the popular demand for lower rates. And those families who are now buying automobiles can buy electrical appliances—if they want to.

Needless plant troubles fade with modernization

"Oh, no, we don't have any trouble" is a common answer of the industrial electrician to the question whether his war-time electrical installation is still giving satisfaction. He is quite right because he has his own definition of trouble. To him it is no trouble to yank out ten open type d.c. motors every week for repair of dirt or water damage. Nor is it much trouble to pull fresh rubber hose every week over some cables to keep them from blowing up because of exposure to oil or chemicals. Continual repairing of antiquated faceplate starters is not annoying to him—it is what he expects. He does not call it much trouble to replace fuses, even though they are in series with a breaker that would give plenty-good protection with the fuses eliminated. Trouble to him is just a sweet day's work, and without troubles he might have little to do but think.

But what is pie for the electrician is very likely to be indigestion and doctor's bills for the management. Inclosed motors, proper cable insulation, appropriate modern starters, removal of superfluous fusing would make for smoother functioning all around and give the electrical staff a chance to think up new engineering ideas to enhance their standing and that of the employers as well.

Every one of these improvements might pay for itself in short order, and along with them would vanish some hazards that are not even so much as taken for granted—they just are not recognized as existing. For example, one industrial plant that conducts a process which brooks no interruption whatever has bottlenecks at several points in its electrical system. At one place all the power is concentrated in a batch of cables that are intertwined like a pail of worms. A fire there would shut down the plant, not for minutes but for days and maybe weeks. But meanwhile they trust blindly and serenely in sporadic measures they have incorporated from time to time to enhance reliability of service to their processes. That plant needs a once-over and a turnover.

No, industrial electrical modernization is not merely a matter of cheapening production by increased output. Much of it is a matter of eliminating troubles that easily get to be the joyous little "keep-busy" activities of the maintenance staff every day. For some people it seems necessary to keep knocking themselves in the head with a hammer just to find out how pleasant it would be not to do it.

Taking the rankle out of motor-starting rules

It is surprising how practices can become ingrained and a matter of habituation. Not until they stir up protests from some corner that experiences conflict with new conditions are they brought up for review and revision. Take motor-starting currents. Without doubt the great majority of utility rules fix the permissible size of motor for across-the-line starting on the basis of its own rating and characteristics. And without doubt this stipulation has rankled many industrial customers, especially those who already have a sizable connected load.

New approach to this situation is being found. It hangs on two items. One is that the harmful effects upon the service to other customers from starting-current bumps depend on how big the added motor is in proportion to the capacity of the distribution system in the neighborhood. Presumably that has been proportioned to the demand and connected load in the vicinity, and therefore it seems logical to fix across-the-line motor sizes in terms of the existing connected load. The second item is that it is the abruptness of the voltage dip that counts more than its sustained magnitude. Consequently the starting-current limitation per step is what should rule.

Combining these two criteria, it appears quite sensible to set up rules that allow an initial block of current per step for each type of motor on each type of distribution system augmented by one or two amperes for each kilowatt already installed. One utility has already moved in this direc-

tion and found that 70 per cent of even the 50-hp. motors that would previously have required starters of some sort could just as well have been thrown directly across the line so far as harm to service was concerned. That utility looks for smoother relations with its industrial customers and it deserves them.

Simple handling charges for interchange energy

Transfer of energy between two power companies under common control when these are separated by an intermediate independent system is likely to involve too much intricacy in the methods of charging for services rendered. Many people concerned with utility regulation do not yet realize that little or no energy passes as a bulk shipment across an intermediate system with local generating plants when working as part of an interconnection chain. Another point is the relation of increment power costs on the different systems to actual charges for energy received, forwarded and taken. The fact that investment charges may not have to be considered in interchanging energy between established systems and in billing the several parties for their share in the transaction is insufficiently appreciated.

For example, company "A" controls "C" and supplies it through independent "B." When business improves, it may be economically desirable to build direct tie lines between "A" and "C," as portions of the territories are probably not more than 15 or 20 miles apart. At present company "B" has spare transmission and generating plant capacity and can supply a certain amount of steam power to "C" under favorable conditions, while at the other end of its system it can interchange with "A" to advantage. The set-up has been simplified by computing the increment costs of energy delivery to each company. The difference in increment costs per kilowatt-hour is divided between the parties as interchange savings and "A" bills "C" directly, although the energy sold "C" comes from the nearest plants of "B." The reward "B" gets for handling the transfer is its proportion of the interchange savings.

Since the systems were already tied together before the financial control of "C" passed to "A," it is possible at present to supply "C" 's needs without increasing the investment of any company. This means that existing plant is utilized which would otherwise remain idle, and therefore no fixed charges enter the situation. The system operators work only on increment costs. Pending the growth of loads in the territories and determination of plans for additional generating and line capacity on a regional basis, these relatively simple methods of handling the price and savings features of the tripartite interchange appear fair to all concerned.

Dollar a year collection cost is too high

Back in 1932, quite a bit before the collection and customer credit situations got acute, J. H. Lobban, chairman of the accounting national section, stated in the N.E.L.A. Bulletin (April number) that it was costing the electric utilities $25,000,000 a year for collection expenses and bad debts written off. That figure certainly did not decrease, but has probably increased materially in the last few months. It represents more than a dollar a year per customer, whether good or bad pay. It also represents 2 per cent of the total collections from domestic and commercial customers, those who entail most of this expense. Avoidance of this loss would pay two-thirds of the federal energy tax levied against utility companies.

There has been a measure of wholesome tolerance in dealing with customers who have suffered reverses. But the utilities are not expected by the general public or by the commissions to be philanthropists. It is expected that such generosity will stay within the bounds of accommodation. Ultimately they are bound to collect all that is coming to them, otherwise there will be discrimination. Records must be kept alive and "findable" so that every one will in the end pay his share. Record systems that were adequate under normal conditions are likely to be found inadequate when today's extra pressure is applied to them. The future seems to hold no escape from the necessity of improving records so that leaks will be stopped and every one will have respect for the effort of the utility to collect its due.

Incidentally these customer record systems give customer relations a chance to start off on the right foot on every new and renewed contact with the customer.

Make Utility Management

By JOHN E. ZIMMERMANN
President United Gas Improvement Company

WHAT is the logical explanation of the attacks being made in all parts of the country upon the electric industry? I believe there are at least four reasons, none of which have anything to do with rates or service.

First, and probably most important, public confidence in the electric industry has been affected by the scandalous and dishonest behavior of the Insulls and of others who apparently did not hesitate to abuse their positions of trust.

Second—Criticism of the electric industry makes a fine issue for the politician who is striving to gain power, because utility customers form a large majority of any electorate, and it is only human, since they pay the rates, to be interested when a promise of lower rates is held out to them. The trolley companies and steam railroads served their purposes in this respect in past times, but the plight to which they have been brought is so serious that the attitude of the public toward them has changed.

Third—The fact that gas and electric operating companies as a group have remained financially sound during a period of great depression, when all other industries were suffering hardships, has left them more subject to exploitation and has created a feeling of suspicion that their relative prosperity must be due to there being something "rotten in the State of Denmark."

And finally, but not the least in importance, I believe public confidence was weakened because, during the boom years of 1928 and 1929, there were unconscionable bankers and investment houses who took advantage of the public's great faith in the earning power and future of the electric light and power industry to promote issues of public utility holding company securities which were unsound and merely "get-rick-quick" schemes.

There is no magic formula to end all our troubles, but there are certain courses to which I believe we of the electric industry should adhere. There is no doubt that the industry should be a monopoly, therefore regulated, and that its profits should only be sufficient to attract at all times new capital at reasonable rates to provide for extensions and betterments to the property. There is no room in the utility business for speculative profits.

If we believe in this, then we should give it more than lip service by rigorously practicing it. I understand this to mean that I am under the duty and obligation to watch the profits of the companies for whose management I am responsible, and that when these profits exceed the fair and reasonable return required to maintain their credits and provide reasonable reserves, the rates should be lowered.

A cost-plus business

Management should remember that a regulated industry of this character is one that is conducting a cost-plus business, because it collects from the public all of its operating expenses, maintenance, depreciation and taxes, plus a return on the capital invested. Regulation to survive means that with it must go the very highest grade of honest and efficient management.

The reintroduction of competition in utilities, even on a restricted scale, is a grievous backward step, and a subsidized, unnecessary duplication of facilities.

Apart from the appalling waste and injustice of this procedure by the federal government, where can be found a municipality with a record of administrative efficiency which invites such use of the general taxpayers' money?

The real question today is whether the power of government through men elected to office shall be used to change the present system without giving to the citizens either true or full information or the opportunity to register their votes. That is what we all today must meet.

If the people want autocracy, if they want to be mere sheep driven from corral to corral, and existing only for the pleasure of their rulers, then it is their right to vote themselves into bondage.

If the people want to abolish private business and set up something like the Russian system, then it is their right to vote that ambition is wrong, that all we have ever been taught in the schools and in the churches is wrong, and that henceforth we shall be human puppets pulled around by strings.

If the people want to vote that private property is

**Abstract of address presented at the meeting of the Corporate Fiduciaries Association, January 22, 1934.*

a Profession!

Abuses of trust, political attacks, depression-proof financial soundness and past profits of promoters have sapped public confidence in the electric light and power industry.

How to win back the confidence and understanding once enjoyed is the predominant problem of the industry.

Making corporate management a profession and holding individual corporate officers to the highest possible professional standards of ethics is Mr. Zimmermann's suggestion. He would even welcome laws to insure it.

wrong, then it is their right to vote the confiscation of all savings and other banks, life insurance companies, building societies and all the other means by which we have been accustomed to provide against the future.

It is the right of every citizen who believes in the socialistic state to advocate such a state. It is the right of every citizen who does not believe in the socialistic state to oppose it. If, in the course of the discussion, each side chooses to question the motives and the honesty of the other and to go in for either plain or fancy mud slinging, then that is perfectly right and proper under our form of government.

But under no conception of our government is it right and proper for duly elected officials to use the power of their offices to bring about fundamental changes in government on which the citizens have not had the opportunity to vote.

Breeding dictators

The situation is not altered if the public officers are in ignorance of the significance of their acts and in all sincerity put forth proposals, in the name of social justice or in the name of recovery, which in fact have nothing to do with either social justice or recovery, but which are really the bringing in of a different kind of government.

We are today breeding, in both our national and our state governments, a race of dictators, petty and otherwise, whose preoccupation seems to be the breaking down of individual effort—breaking down the right of a man to the dollar that he earns. These budding dictators feel free to use the full power of their offices and the money of the taxpayers to destroy, directly or indirectly, the property of the taxpayers and to alter their lives to conform to some pattern designed by the dictators.

Against this new force of government the citizen has no recourse except his ballot. If he be not fully and accurately informed he is not in a position to use his ballot. The ballot can be used only periodically, and it becomes useless if the real issues are seldom or never presented for a vote. That is nearly the case today. We are being ruled, in a large measure, not by laws made in legislative chambers, but by laws made in executive chambers, and the shaping, even the controlling, of public opinion by the government is a necessary part of this executive legislating.

The great change in the method of government without a change in its form has, in my judgment, put upon the managers of great corporations a new responsibility. From the soapboxes it is still said that corporate managers represent capitalism—whatever that may be. Corporate managers do not represent capitalists. They are managers of property belonging to others and given over to the service of others.

The duty of the managers is equally plain. They have to run the business at a profit to the security holders, the employees and the customers. The managers may be dishonest and run the corporation for their own benefit. They may pay themselves extortionate salaries, speculate with the profits of the corporation, sell stock short against bad news, or otherwise violate their trust. Any manager of a corporation may be a thief and he may do a lot of what amounts to stealing within the law. Those few people who believe that all men are dishonest, and that the only difference between them is that some get opportunities and others do not, can cite plenty of cases to show that all corporate officers are thieves and that remarkably few get caught. But there are also those who apply this same line of reasoning to politicians, to the chastity of women and to all human relations. If all men are dishonest according to their opportunities, then there is no point in bothering about anything, for those who administer the laws will be just as dishonest as those whom the laws are supposed to catch and punish.

Exceptions do not prove the rule

Following such a line of thought leads only to despair and futility. In common with every decent business man, I have been shocked by the glaring cases of faithlessness in high and responsible offices during the past few years. Every one of these cases has had to do with individual conduct either on the borderland of business ethics or actually beyond the law. None of them were the result of the present methods of business organization, any more than a plundering government officer is a result of our form of government. It is not possible to meet these situations by more laws and more regulation. A commissar can default on his honor just as easily as a bank president. This happens to be a world of human beings, and while it is absurd to say that all human beings are dishonest, it is equally absurd to say that they are all honest. I take the position, however, that with the growth of corporations, their officers must be held to higher standards than men who are administering only their own private affairs. I disagree entirely with those who deplore the fact that today the officers and directors of great corporations are in no sense the owners of the corporations and in many instances hold only a small amount of the securities. I think this is an advantage; first, because it offers opportunities to the poor man who has managerial ability but who is in no sense a capitalist, and, second, because it opens the way to making corporate management into a

profession and holding the individual corporate officers to the highest possible professional standards of ethics.

The Century Dictionary defines a profession as "a vocation in which a professed knowledge of some department of science or learning is used by its practical application to affairs of others."

According to this definition, the managers of large corporations are following a profession, and I should welcome laws so defining those standards as to make it impossible to give only lip service to them. I believe that full non-technical corporate reports, which any man can read and understand, are the best guaranty that those who make the reports are not transgressing the highest ethical principles.

Human factor at fault

Believing that the human factor and not the system is at fault, I hold without qualification, that the present system of private ownership—although sometimes it runs most imperfectly—is the best product to date of our experience; that this system can be brought to a higher degree of perfection in the future than can any other system, and that it would be anti-social to change it without a full examination of all the facts. Therefore, it becomes my duty, and the duty of all those who believe in the essential soundness of the system, to defend it against purely destructive attacks, while at the same time seeking constructive criticism which will aid in repairing the weak spots.

The corporate manager is today the man who must defend the system. Also he is the man who must improve it.

It has always been the recognized duty of corporate management to seek the passage of laws which would facilitate the conducting of the business in the public interest and to oppose the passage of such laws as would hamper the conduct of business without a corresponding benefit to any one. Of course there are plenty of instances in which utility and other corporations have sought laws against the public interest and plenty of other instances in which laws against the utilities have been proposed for wholly venal reasons. There has been scandal in getting laws and scandal in preventing them. All of which does not in the least alter the plain duty of every responsible corporate head to advocate good laws and to oppose bad laws. It is also the plain duty of a corporate head to present his corporation honestly and straightforwardly to the public, to the end of gaining favorable public opinion based upon the facts. Now it seems to be the equally plain duty to take a long step beyond all this and, in a purely professional capacity as the managers or trustees of many interests, to present the facts to the public in order that the public may judge whether minorities in executive positions are or are not legislating into being policies which the people do not want and which are not in their best interests.

In conclusion, let me say that the following quotation, taken from an essay written by Lord Macaulay in 1830, aptly expresses that which I conceive to be the true function of government:

"Our rulers will best promote the improvement of the people by strictly confining conditions to their own legitimate duties, by leaving capital to find its most lucrative course, commodities their fair price, industry and intelligence their natural reward, idleness and folly their natural punishment; by maintaining peace, by defending property, by diminishing the price of law, and by observing strict economy in every department of the state. Let the government do this—the people will assuredly do the rest."

A Better Ozone Test for Rubber Cable

By P. F. BAGGISH and W. H. MEADE, Jr.
Standardizing and Testing Department,
Edison Electric Illuminating Company of Boston

That the laboratories of both manufacturers and users of cable may secure comparable results in subjecting rubber cable to the ozone test an improved standardized method has been developed

SINCE the importance of a fairly accurate ozone test[1] upon rubber cable that can be readily duplicated in various testing laboratories has been fully realized by both manufacturer and cable user, the following means have been devised. Its simplicity of operation and concentration checking makes it readily adaptable for control work in the testing laboratory.

The ozonizer (Fig. 1) was designed for a closed continuous flow and consisted of an ozone-generating chamber, a constant-speed blower and testing chamber all in series. Conditions governing the rate of ozone generation, such as humidity and temperature of the air, necessitated a simple means of obtaining the concentration of ozone in the system without materially affecting the equilibrium of the cycle. For this, the gas burette method shown in Fig. 2 was devised and worked successfully.

To test rubber cable specimens of it are bent around a mandrel having a diameter equal to five times that of the cable and placed in the ozone-test chamber, where they are subjected to a concentration of 0.008 per cent O_3 for three hours. The temperature of the test atmosphere should be between 65 and 75 deg. F. and the relative humidity between 60 and 70 per cent. This test has been accepted as our standard after considerable research.

[1] *The use of ozone as a means of testing high-voltage rubber cable was first suggested by Peritor when he published the results of the effect of corona on rubber subjected to high voltages. "Gummi Zeitung," 40.95 (1925).*

In preparing the samples for test, which sometimes includes stripping protective coverings from the rubber, care must be taken not to damage the surface of the specimen. This is quite essential because some so-called ozone-resisting rubber cables depend on a specially treated outside surface to furnish this quality. Considerable care must also be taken in bending the specimens around the mandrel so the stresses set up by this operation will be evenly distributed over the outside surface of the bend.

The effects of ozone on non-ozone-resisting cable will be in the form of cracks on surfaces under tension and "crumbling" on surfaces under compression. The cracks will enlarge upon continued exposure to the ozone until the tension on the rubber, set up by bending, has been relieved due to the opening of the cracks. In like manner the crumbling will continue until the pressure is relieved.

Experiments on the influence of atmospheric conditions showed a decided decrease in the concentration of ozone on a particularly humid day. Hardly any effect was produced by temperature. An attempt to effect dilution by opening a petcock in the system proved unavailing since the system is under pressure. Under all conditions an equilibrium period of twenty minutes was allowed before sampling. Samples from any of the sampling cocks had slight differences in concentration.

A more complicated equipment designed by the Anaconda Wire & Cable Company controls the temperature and humidity as well as the concentration of the ozonized air. This apparatus is more adaptable to research and development work in ozone-resisting compounds. Its components are outlined in Fig. 4.

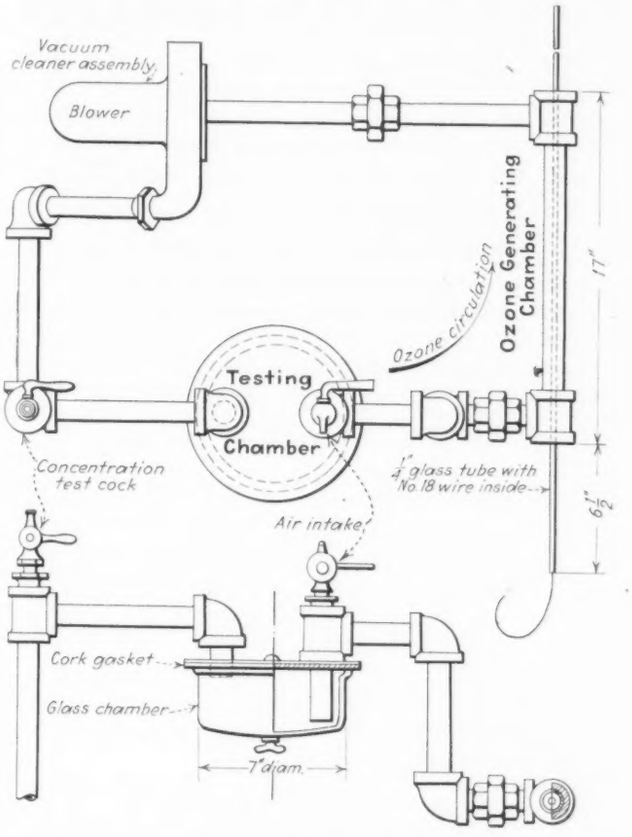


Fig. 1—Ozonizer used for testing rubber cable

The ozonizer proper consists of a ¼-in. glass-tubed No. 18 copper wire cemented into a section of ¾-in. cast-iron pipe. This is directly piped through a blower fan to a testing chamber 7 in. in diameter, and then back again through the generating chamber. The potential furnished to the ozonizer is supplied by a 200-watt, 24,000/110 = volt transformer and is the means of regulating the ozone concentration. Test cocks were placed at different locations to determine the possible variance of the concentration during the cycle of flow.

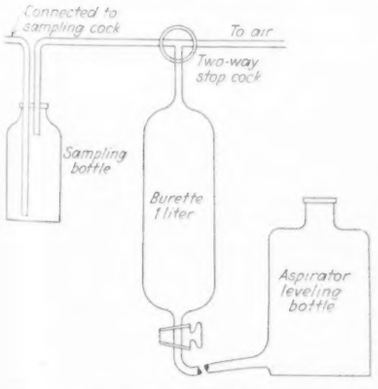


Fig. 2—Gas analyzer for checking ozone concentration

Thirty-five c.c. of a 1 per cent potassium iodide solution and a few drops of freshly prepared starch are placed in the sampling bottle. The two-way stop cock is opened to the air and the burette filled to the mark with water by lifting the aspirator bottle. Then the stop cock is closed to the air and opened to the sampling bottle; at the same time the sample cock is opened on the ozonizer. By lowering the aspirator bottle exactly one liter of gas is bubbled through the potassium iodide solution. The liberated iodine is titrated in the bottle with standard sodium thiosulphate.

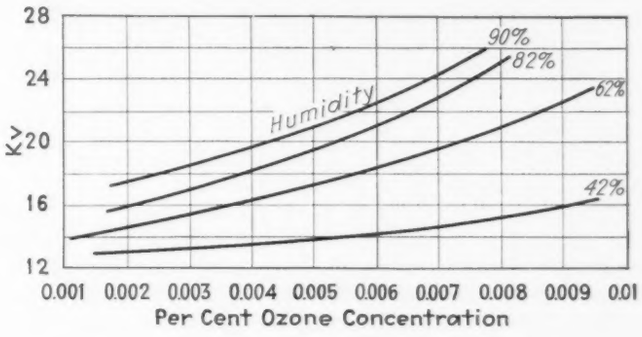


Fig. 3—Increase of humidity greatly reduces ozone concentration

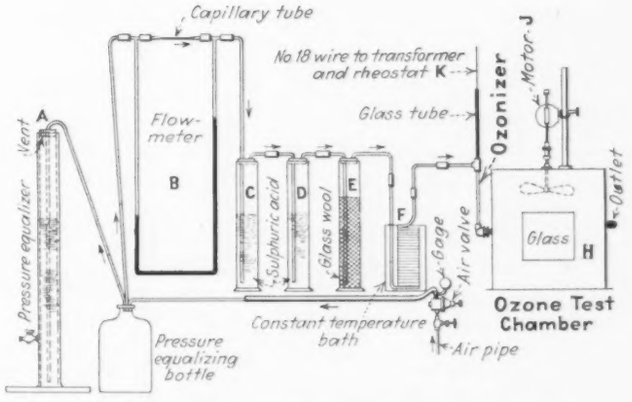


Fig. 4—Ozonizer with controlled temperature, humidity and concentration

The humidity of the air can be varied by changing the concentration of the sulphuric acid in *C* and *D*. After being conditioned for humidity in *C*, *D* and *E*, the air passes through a coil in the constant-temperature bath (F) before passing through the ozonizer (G). The overflow outlet on the ozone test chamber (*H*) affords an easy means for withdrawing samples for ozone concentration tests.

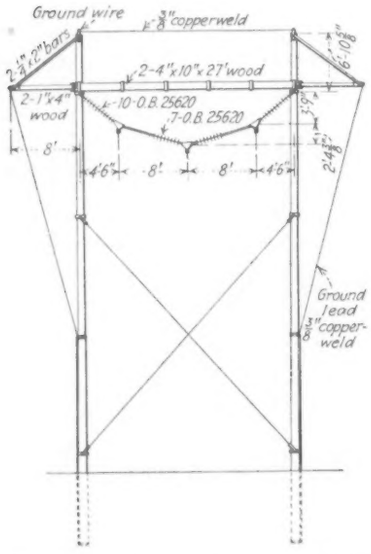
Unconventional Wood Line Gives Good Performance

To produce a transmission design where the line wires are close together, ground wires are far apart and large clearances are allowed between line and grounded conductors, engineers developed the "necklace" construction.

Successful results over a period of two years show not an accidental outage from either electrical or mechanical causes.

IN AN attempt to produce a compact wood-pole H-frame high-tension-line construction which would utilize the insulating value of the wood and still be free from both lightning flashovers and pole and crossarm splintering, an experimental installation of an unconventional cradle or necklace form of construction designed by J. A. Johnson, chief electrical engineer of the Buffalo, Niagara & Eastern Power Corporation, has been in successful operation on the New York Power & Light Corporation's system near its Spier Falls plant for about two years. Since it was built in 1931 this 110-kv. line has never suffered an accidental outage from either electrical or mechanical causes, although a closely adjacent 110-kv. double-circuit steel tower line and a double-circuit 33-kv. wood pole line crossing it have both had several lightning flashovers. Undoubtedly some degree of shielding must be accorded the close proximity of the steel tower line in evaluating the perfect lightning record of the cradle-type wood-pole line. However, impulse tests in advance of the construction substantiated the apparent ability of the wood insulation as used in the design to prevent flashover.

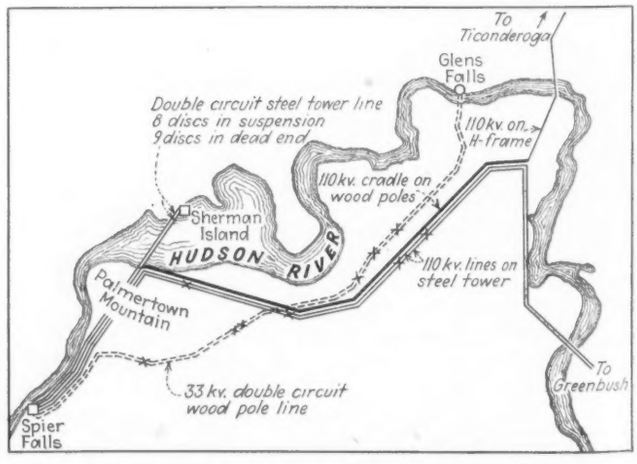
The two 60-ft. poles of each frame are 25 ft. apart and connected by a heavy wood crossarm designed to resist the compression resulting from the weight of the conductor and ice loads. All three No. 4/0 copper conductors are supported between the poles in substantially fixed position by a cross catenary "necklace" of standard suspension insulators. Conductors are spaced 8 ft. apart horizontally, the center conductor being about 38 ft. from the ground at the structure, the other two slightly higher. The two poles extend about 6 ft. above the crossarm and each carries a ⅜-inch overhead "Copperweld" ground wire. At each structure the ground wires are connected together by a "Copperweld" conductor. Light outrigged wood arms extend 8 ft. out from the poles in line with the crossarm. Grounding of each overhead lightning wire is effected by two strap steel braces from the pole top down to the end of the outrigger and then by a "Copperweld" gound lead obliquely to the pole and thence to the ground at the base of the pole. The purpose of this construction is to produce a structure with the line wires close together, ground wires far apart and with large clearances between line and grounded conductors.



Conductors hung from insulator cradle between poles of H-frame

Crossed steel guy wires stiffen the pole structure. Impulse flashover tests indicate that the ground leads could probably just as well have been brought to the poles at the same point as the upper ends of these guy wires, as such modification would probably not reduce the flashover voltage from the outside conductors.

Spans are normally 550 ft. and there are 60 spans in the 6.85 miles of this construction, all lying parallel to the twin circuit steel tower line already mentioned. The cost per mile from clearing right-of-way to completion



Adjacent lines flash over but cradled line immune
X marks locations of 1932-1933 flashovers

was about $7,250, almost exactly one-third of which was labor and transportation. These costs are not, however, to be taken as too significant because the work was carried out under unfavorable conditions and further economies in design are indicated as a result of this trial installation.

Impulse tests indicated high performance

Extensive impulse flashover tests were made by A. O. Austin at the Barberton laboratory of the Ohio Insulator Company before the line was built. All values found there must be modified, however, to take account of the eleven and eight disks per string used in the tests as against the ten and seven actually used in building the line. An abrupt wave-front with 100 microseconds from crest to 50 per cent attenuation was used in the impulse tests. With these conditions it was found that the impulse flashover was from 1,190 kv. to 1,460 kv. wet and 1,720 kv. dry, showing the effectiveness of the wood insulation. Austin's conclusion was that the flashover values were "undoubtedly much higher than on any steel tower line" then existing on the Niagara Hudson system.

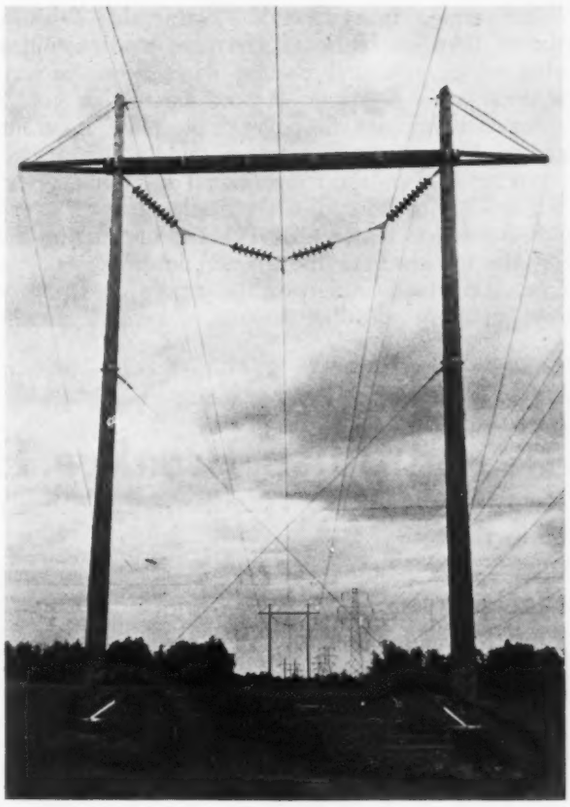
To prevent possible burning due to leakage and charging currents under fog conditions the feasibility of using a bleeder resistance was also subjected to test. It developed that flashover with a 71,000-ohm bleeder resistance bridging the pole top from overhead ground wire to insulator attachment occurred at 1,090 kv. with a negative impulse and 1,140 with a positive impulse, dry conditions.

It was also concluded from the Barberton tests that the structural arrangement would give effective insulation for the release of a bound charge as the equivalent flashover voltage would be raised from 1,150 kv. to about 2,100 kv. With the comparatively low height of conductors in the design the latter figure would be more than ample to prevent flashover from the release of a bound induced charge on the line.

Alternatives also studied

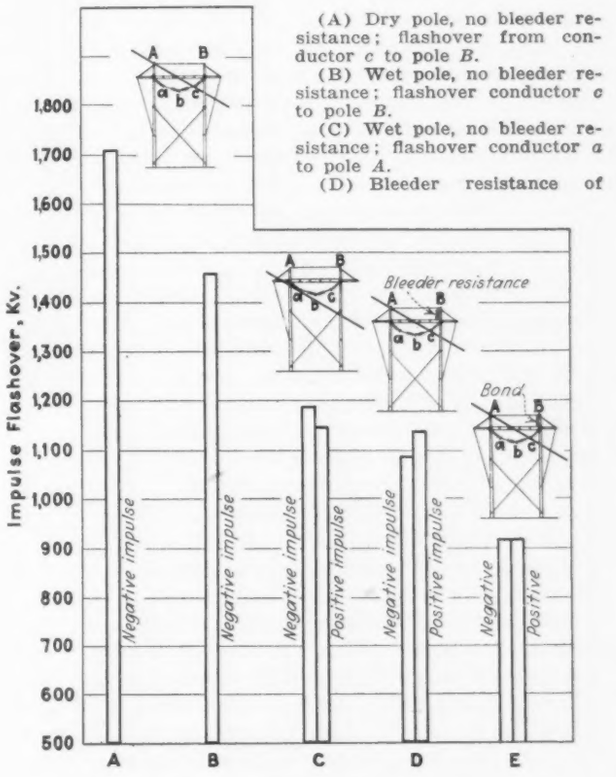
During the field laboratory studies a comparison was made of the necklace design with conventional H-frame construction connected in parallel. Throughout these tests six disks were used on the multiple-plank crossarm of the conventional H-frame structure. When the H-frame arm was bonded and down wires used on its poles the six units flashed over at 513 kv. with either positive or negative impulse. When the arm was not bonded, however, the negative impulse of 1,030 kv. arced between phases of the necklace construction. In these two tests the outer phase wire was energized and the middle one grounded. Reversing these (i.e., energizing the middle wire and grounding the outer phase wires) resulted in a 1,030 kv. positive impulse arcing between phases of the necklace structure. However, removing the ground from the outer conductor shifted the flashover (1,205 kv. positive) to the six disks and crossarm at the standard H-frame.

Shunting the pole-top of the necklace design with a wire resulted in a 920 kv. negative or positive impulse flashover on its eleven-disk string. With the pole top shunted by the 71,000-ohm bleeder resistance flashover from the outer phase conductor took place to the insulator support at 1,140 kv. positive and 1,090 kv. negative. For normal conditions of operation it appears that the



Wood insulation the objective in this construction

Six feet of pole top and eight feet of crossarm between circuits and ground wires



(A) Dry pole, no bleeder resistance; flashover from conductor *c* to pole *B*.
(B) Wet pole, no bleeder resistance; flashover conductor *c* to pole *B*.
(C) Wet pole, no bleeder resistance; flashover conductor *a* to pole *A*.
(D) Bleeder resistance of 71,000 ohms shunting pole top; flashover conductor *c* to pole *B*.
(E) Insulator support bonded to ground wire; flashover conductor *c* to pole *B*.

Impulse tests show efficacy of wood as insulation

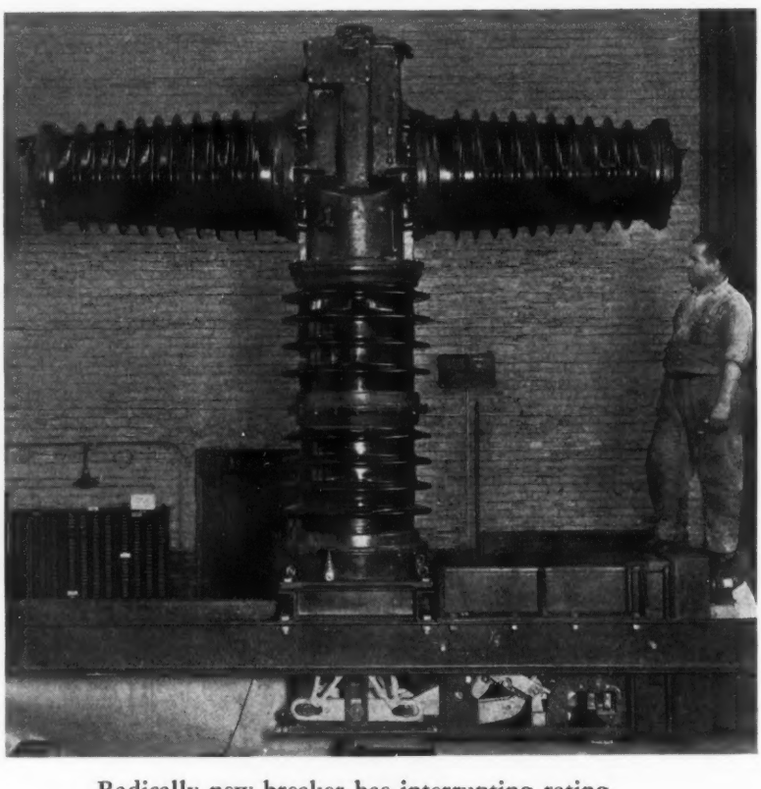
necklace design is by test less vulnerable to impulse flashover than conventional H-frame construction with double wood arms and ground wires down each pole. For this normal condition of both assemblies the 1,205-kv. negative impulse flashover took place horizontally over the 77-in. air gap between middle conductor and the ground lead on the conventional H-frame. For the 1,205 kv. positive impulse the flashover was over the six-disk string to the middle of the wood arm and thence along the crossarm to the ground lead.

One distinct advantage of the cradle construction is the opportunity afforded to add a second circuit by merely erecting one additional pole per structure and extending the crossarms. Also, the close spacing of conductors made possible by their comparatively rigid support results in a considerable reduction in the impedance of the line, and in combination with the widely spaced ground wires should afford somewhat better protection from direct lightning strokes than would be possible in the conventional H-frame design. The successful operation of this line for a period of two years indicates that no trouble has been experienced or need be anticipated on account of its unconventional mechanical design.

Impulse Breaker Has Bushing Dimensions

With an oil requirement of but 96 gal. per pole, as compared with the conventional 1,700, this new 1,500,000-kva. at 138-kv. breaker offers a radical advance in design

By D. C. PRINCE
General Electric Company, Philadelphia



Radically new breaker has interrupting rating of 1,500,000 kva. at 138 kv.

It contains 96 gal. of oil per pole, compared to nearly 1,700 gal. per pole in the equivalent conventional tank-type breaker

It may be difficult to imagine a high-voltage, large-capacity oil circuit breaker in which the container for each pole, inclosing the interrupting structure, is only slightly larger than the bushing used on an equivalent conventional breaker. Yet such a device has been developed, anticipating the time when even higher speed breakers, with short arcing times and containing little oil, will be required to give quicker relief to apparatus or cable in trouble, to assist in maintaining system stability and to reduce fire hazard.

A conventional circuit breaker bushing has always been called upon to carry both the load and the short-circuit currents. It has insulated the line from ground. In addition, it has sufficient end-to-end creepage distance to produce circuit isolation with the conductor omitted. A single bushing per phase, inclosing the necessary circuit-interrupting parts, might thus be said to be the ideal circuit breaker design.

The new high-voltage impulse breaker comes very close to this ideal. In this breaker each pole consists of a tube, not much larger than a conventional bushing, mounted horizontally with an insulating support at its center. The central support contains a current transformer, when required. The insulated operating rod passes through this support to the mechanism housed in the base. Within the horizontal tube are several sets of contacts in a line, this arrangement permitting a uniform potential grading not readily possible in a multi-break tank type breaker. The inside of the tube is so arranged that oil, driven by a piston in the central casting, is positively directed across the arc path of each of the several breaks during circuit interruption.

The oil velocity is calculated for the worst condition of circuit recovery voltage rate. The interruption is positive at all currents, with a very short arcing time, and therefore the stroke can be short. Damage to machinery, burning of line conductors, cracking of flashed-over insulators, transmission system stability—all approach the optimum with a uniformly quick-acting circuit-interrupting device.

How Off-Peak Water Heaters Affect System Investment

By H. GEORGE D. NUTTING
Detroit Edison Company, Detroit, Mich.

Against the desirability of securing the additional load and revenue that the promotion of off-peak hot water heating brings, executives must carefully balance the probabilities of increased system investment.

Detroit Edison has made a detailed analysis. Feeders, transformers, secondary services, generating capacities and switches and meters have been carefully considered. With a liberal generating reserve other costs are so small as to be highly encouraging.

ONE of the questions that arises in consideration of off-peak heater policy is, "will any additional system investment be necessary to secure this new load?" No general answer can be given to this question. But the following analysis of conditions in the system of one large power company shows by example a method of tackling the problem:

Effect on Feeders from Substations—In this particular case the feeders from the substations to the distribution centers are No. 4/0 cable operating at 4,800 volts. Each feeder system will carry conservatively 2,000 kw. However, the feeder regulators at the substation are rated at 1,500 kw. each, which therefore limits the feeder capacity to 1,500 kw. The present feeder peak is 750 kw. and it occurs between 7 p.m. and 9 p.m. At 9 p.m. the load drops to 650 kw. and at 10 p.m. it drops to 550 kw. Therefore, the capacity which could be added, in electric water heaters, coming on at 10 p.m. is 1,500 kw. — 550 kw. = 950 kw.

This would permit the installation on this feeder of 950 kw. ÷ 2 = 475 2 kw. electric water heaters, without any additional feeder expense. If the regulators were changed to carry 2,000 kw. an additional 500 kw. of capacity would be available and an additional 250 2-kw. electric water heaters could be installed.

The maximum number of residence customers per feeder in this particular case is 600. It is seen, therefore, that 475 customers out of the 600 could have 2-kw. electric water heaters without any change in the feeders. For safety's sake it should be figured that the natural increase of feeder load will be, say, 33⅓ per cent over the present. That is, the conservative maximum demand at 10 p.m. would be 1⅓ × 550 kw. = 733 kw.

Then there will be available for water heating without increased feeder facilities 1,500 kw. — 733 kw. = 767 kw., or 383 2-kw. water heaters out of, say, 750 or 800 customers. In other words, it may be conservatively stated that, so far as the feeders are concerned, 50 per cent of the customers served by a given feeder can have off-peak water heaters without any additional investment in facilities.

Capacity of Distribution Transformers—This also will depend upon local practice. In the particular case referred to the transformer sizes are selected for a diversity of three to one in ordinary residence districts (say $2,000 to $15,000 houses) and for two to one in the districts having higher cost houses, say $15,000 to $50,000. Where there are any goodly number of electric ranges the diversity is figured at one to one, or rather 1 kw. per customer on residence peak. Transformers are spaced 600 ft. to 700 ft. apart and the secondaries starting out from the transformers are No. 2. The service drops are No. 8 for two-wire services and No. 6 for three-wire services.

A lot of variation may exist as to the present loads on transformers compared to their capacities. In congested districts using banked systems the transformers are usually selected to operate at 75 per cent of their capacity during the peak hours (7 to 8 p.m.). In scattered districts, where radial distribution systems are used, transformers will seldom be loaded to 60 per cent of their capacities. The load rapidly drops after 8 p.m., so that at 10 p.m. it will be about 60 per cent of the peak. This means that a 10-kw. transformer will normally serve on the residence peak 10,000 watts × 75 per cent load ÷ 300 watts per customer = 25 customers in ordinary districts. In higher class districts it will serve half this many, say twelve customers, and in districts quite saturated with ranges it will serve eight or nine customers.

Little more transformer capacity needed

In any case, the load after 10 p.m. will fall off to about 60 per cent of the peak. This releases 10 kw. — 6 kw. = 4 kw. for off-peak water heating, which means that even after 10 p.m. on the average only two 2-kw. water heater customers can be put on a transformer without overloading the transformer. Inasmuch as water heaters will usually be put in where there are already ranges it is concluded that on the average 20 to 25 per cent of the customers can be equipped with 2-kw. water heaters without increasing transformer investment.

In some districts the conditions will be such that 100 per cent of the customers will need to have electric water heaters. That is, eight customers who have ranges and

who normally would be served by a 10-kw. transformer would all put in off-peak water heaters. Six of these customers would require additional transformer capacity totaling 12 kw. at an investment cost of, say, $120. The annual fixed charges on this additional transformer capacity are, say, 15 per cent of $120 = $18. The eight customers would use about 24,000 kw.-hr. per year for water heating, therefore the increment cost of the transformer increase per kilowatt-hour is 18 ÷ 24,000 = $0.0008 or, better, say $0.001. This is not much to worry about, but needs to be considered in making a water-heating off-peak rate.

The necessity for increased transformer investment exists only where there is some considerable concentration in water-heater installations in certain districts. As shown above, each 10-kw. transformer or equivalent can stand the addition of two off-peak water heaters. A conservative decision would be to include the cost of $0.001 per kilowatt-hour in the estimates of cost of serving the water-heater customers.

Distribution Secondaries—Good practice is to use No. 2 conductors for the secondaries starting at the transformer. Taking a 10-kva. transformer as a basis, the secondaries would run about 300 ft. each way. Assuming an equivalent concentrated load at 150 ft. from the transformer, a No. 2 cable will carry about 100 amp. with a 2½ per cent drop in voltage. This means practically 23 kw. at 230 volts.

As shown above, 100 per cent saturation of off-peak water heaters would call for a load at 10 p.m. of 22 kw. on the secondary. It is seen that the No. 2 cable is sufficiently large, and, in general, no investment is needed in secondaries, except occasionally an increased size of service drop.

Effect on the Substation—In this particular case we find a typical residence substation has a safe carrying capacity of 17,000 kw. The actual peak load is 9,500 kw., and it occurs in the daytime. At 10 p.m. the load is 6,000 kw. Therefore, there can be added to the load on this station at 10 p.m. 17,000 kw. —6,000 kw. = 11,000 kw. This would take care of 5,500 2-kw. off-peak water heaters. The number of customers on this station is about 20,000. Therefore, about one-fourth of them could be equipped with 2-kw. off-peak heaters without increasing the substation facilities. It is doubtful if this number of electric water heaters could ever be sold.

Transmission Lines—Transmission lines are generally designed liberally enough to carry full loads on substation transformers, with some reserve, so that no fear may be had that they would have to be increased on account of off-peak electric water heaters.

Power House Load.—The normal power house (or system) peak is 500,000 kw. Above this there is maintained some 200,000 kw. for reserve. The load at 10 p.m. is 380,000 kw. There is available, therefore, for increased load after 10 p.m. 500,000 kw. —380,000 kw. = 120,000 kw. This will allow the addition of 60,000 2-kw. electric water heaters. Assuming there are now 450,000 residence customers, this means that $\frac{60{,}000}{450{,}000}$ or 13.3 per cent can have 2-kw. off-peak water heaters without adding anything to the power generation facilities.

It is believed that even the best possible rate will not sell off-peak water heaters to the extent of 13.3 per cent of the total number of residence customers. In any case, half of the power reserve might be considered available, say, 100,000 kw., and this would permit the installation of off-peak water heaters for another 50,000 customers.

Customer's Premise Investment—This will depend upon the policy adopted as to time switches and meters for the off-peak service. For those places where only a time switch is installed about $20 will have to be invested by the company unless the customer is charged for the time switch. If a meter is used on the off-peak service add another $8.

Annual fixed charges 15 per cent of $28	$4.20
Maintenance, billing, etc. (annual)	7.00
Total annual cost of customer's service	11.20
Add profit 8 per cent of investment	2.24
	$13.44

Assuming an average use of 3,000 kw.-hr., this amounts to a cost $13.44 ÷ 3,000 = $0.00448 per kilowatt-hour.

Conclusions

1. Off-peak water heaters can be put on 50 per cent of the residence customers without increasing feeder investment.
2. In general, $0.001 per kilowatt-hour will need to be included in the cost for additional transformer investment.
3. Off-peak water heaters can be put on 100 per cent of the residence customers without increasing secondary cable investments.
4. Off-peak water heaters can be put on 13.3 per cent of the residence customers without increasing power house capacity.
5. Where time switch and meter are owned by the company $0.0045 per kilowatt-hour will need to be included in the increment cost of service for them.

Under the Heavy Hand of Government

The public has been led to believe that, notwithstanding the depression, the utilities have sustained no losses and in no wise have suffered with their fellow men. We of the fraternity are well advised that nothing could be further from the truth. During the past year gas and electric revenues in Iowa alone have fallen off in excess of two millions of dollars. Industrial, commercial and domestic service show an alarming decline. For the first time in a decade we behold the counters of our stores filled with kerosene lamps; factories are boarded up; commercial displays have ceased to exist. Streets and public places are dark and yawning caverns, extending their invitation to the lawless to work their trade, while the collection of accounts for service actually rendered has become almost a lost and forgotten art.

B. J. PRICE,
President Iowa Public Service Company, addressing the Iowa Public Utilities Association.

Census Reports Commercial and Municipal Comparisons

Supplementing, amplifying and in some instances slightly revising figures previously announced as a result of the quinquennial census of electric light and power establishments for 1932, the Bureau of the Census has issued a summary of commercial and municipal operations. More detailed data on some of the items covered have already been published in the ELECTRICAL WORLD, especially the issue of January 6, 1934, on pages 14 and 15. Others have appeared in the News Section almost every week since October 14, 1933.

The 1932 census provides the first separate statistics for commercial companies and for municipal establishments since the announcement of the results of the census for 1927. Also, the new statistics are somewhat fuller, especially with reference to municipal plants, so that comparisons between the two sets are not in all respects possible.

The number of commercial establishments reached its peak in the census of 1917, when there were 4,224. The municipal maximum was in 1922, 2,518. Consolidations have cut the former by 61.8 per cent. The decrease of 28.3 per cent in number of municipals has been due mainly to the absorption of small ones by commercial companies, for in actual magnitude this group has increased. Their rate of growth has, however, been somewhat slower than that of the commercials.

Aside from numbers, municipal plants exceed the others in one item —output from internal combustion engines.

U. S. Census, 1932 (Figures are preliminary and subject to revision)

	Total	Commercial	Municipal	Per Cent of Total: Commercial	Per Cent of Total: Municipal
Number of reporting establishments, total	3,418	1,616	1,802	47.3	52.7
Number of separate generating stations, total	4,339	3,391	948	78.2	21.8
Prime movers:					
Total number	11,185	8,626	2,559	77.1	22.9
Total horsepower	47,966,962	45,191,313	2,775,649	94.2	5.8
Steam turbines—					
Number	2,822	2,298	524	81.4	18.6
Horsepower	32,904,158	31,409,076	1,495,082	95.5	4.5
Steam engines—					
Number	1,299	880	419	67.7	32.3
Horsepower	649,476	505,110	144,366	77.8	22.2
Internal-combustion engines—					
Number	3,298	1,974	1,324	59.9	40.1
Horsepower	881,301	507,413	373,888	57.6	42.4
Hydro-turbines—					
Number	3,766	3,474	292	92.2	7.8
Horsepower	13,532,027	12,769,714	762,313	94.4	5.6
Generators, by type of prime mover:					
Total number	11,111	8,561	2,550	77.0	23.0
Total kilowatt capacity	34,622,554	32,647,578	1,974,976	94.3	5.7
Steam turbines—					
Number	2,829	2,305	524	81.5	18.5
Kilowatt capacity	24,032,842	22,955,221	1,077,621	95.5	4.5
Steam engines—					
Number	1,291	878	413	68.0	32.0
Kilowatt capacity	452,582	356,604	95,978	78.8	21.2
Internal-combustion engines—					
Number	3,274	1,952	1,322	59.6	40.4
Kilowatt capacity	597,628	342,785	254,843	57.4	42.6
Hydro-turbines—					
Number	3,717	3,426	291	92.2	7.8
Kilowatt capacity	9,539,502	8,992,968	546,534	94.3	5.7
Output[1], kilowatt-hours, total	111,715,765,636	106,328,404,464	5,387,361,172	95.2	4.8
Reported as generated, total	79,657,466,651	75,692,668,065	3,964,798,586	95.0	5.0
By steam	45,374,873,980	43,614,446,285	1,760,427,695	96.1	3.9
By Internal-combustion	715,142,922	319,361,140	395,781,782	44.7	55.3
By water	33,567,449,749	31,758,860,640	1,808,589,109	94.6	5.4
Reported as received from other sources	32,058,298,985	30,635,736,399	1,422,562,586	95.6	4.4
Number of customers served, total	23,861,642	21,633,602	2,228,040	90.7	9.3
Ultimate consumers[2]	23,858,411	21,630,662	2,227,749	90.7	9.3
Resale	3,231	2,940	291	91.0	9.0
Revenue from electric service, total	$1,975,303,955	$1,854,109,509	$121,194,446	93.9	6.1
Ultimate consumers[2]	$1,821,105,524	$1,703,303,728	$117,801,796	93.5	6.5
Resale	$154,198,431	$150,805,781	$3,392,650	97.8	2.2
Kilowatt-hours sold, total	88,265,073,126	83,936,789,411	4,328,283,715	95.1	4.9
Ultimate consumers[2]	65,895,975,835	62,147,695,152	3,748,280,683	94.3	5.7
Resale	22,369,097,291	21,789,094,259	580,003,032	97.4	2.6
Kilowatt-hours distributed for other purposes (non-revenue):					
Free service	379,421,146	29,268,248	350,152,898	7.7	92.3
Energy used by reporting establishments	1,466,474,092	1,373,801,821	92,672,271	93.7	6.3
Energy lost in transmission, distribution, conversion, etc.	13,692,065,445	13,081,319,623	610,745,822	95.5	4.5
Energy sent out of state in which generated, not reported as sold	4,962,049,578	[3]	[3]	.....	....
Energy exchanged, not reported as sold[4]	2,950,682,249	[3]	[3]	.....	....
Operating expenses[5]	$803,100,258	$736,692,735	$66,407,523	91.7	8.3
Fixed capital[6]	$12,664,376,952	$12,124,807,425	$539,569,527	95.7	4.3
Fuel consumed for electric generation:					
Anthracite, tons (2,240 lb.)	1,392,040	1,369,136	22,904	98.4	1.6
Bituminous coal, tons (2,000 lb.)	25,998,430	24,093,551	1,904,879	92.7	7.3
Coke, tons (2,000 lb.)	152,841	152,841	.....	100.0	....
Fuel oil or gasoline (bbl. of 42 gal.)	7,867,985	5,904,706	1,963,279	75.0	25.0
Gas—					
Manufactured (1,000 cu. ft.)	1,936,336	1,933,364	2,972	99.8	0.2
Natural (1,000 cu. ft.)	96,365,126	91,049,719	5,315,407	94.5	5.5

[1]Includes generated output and energy received from other sources. Since the energy "received from other sources" was, in a large part, purchased from other electric light and power companies, a considerable duplication is involved, as such energy would also be included in the "generated."

[2]For detail to "ultimate consumers" see Electrical World, Jan. 6, 1933, page 15; also December 16, 1933.

[3]Withheld to avoid disclosing operations of individual establishments.

[4]Data incomplete, since item was not called for on schedule; however, many establishments reported this item separately.

[5]Includes cost of fuel, purchased power, salaries and wages, and maintenance expense.

[6]Plant and equipment, real estate, etc.

Spare Capacity Fixed by Probabilities of Outage

By S. A. SMITH, Jr.

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It is the purpose of this article, first, to call attention to the possibility of a rational solution of the problem of spare capacity by means of the theory of probability; secondly, to present an example of such a solution, using as an illustration a hypothetical power system and applying the principles to the generating units, and, finally, to present the results of certain calculations which will serve as a rough guide to the number of spare generating units required in systems of various size.

Many considerations which cannot be disregarded in a more complete treatment of the problem of spare units have been intentionally omitted. For example, it must be taken into account that units in actual systems are rarely of uniform capacity, that some of the reserve units run and others stand idle, and that load loss may occur not only at the time of the peak demand but at other loads as well. In a subsequent article another method will be presented, and the solution of a problem involving some of these practical aspects will be given.

IN THE engineering of power systems one of the most important objects is the attainment of a high degree of continuity of service. In attempting to achieve this many millions of dollars are spent for reserve equipment and protective devices. Seldom, however, is the proper degree of service reliability known or defined in quantitative terms, and rarely does the designer employ a truly rational method to attain it. Some way of defining the goal must be found and some scientific means of reaching it sought.

The necessity for reserve equipment arises because no one has ever been able to build a machine which can be relied upon to run day in and day out without, sooner or later, either requiring maintenance or breaking down from some cause not altogether foreseen. When such interruption occurs the purpose for which the machine was intended cannot be served until repairs have been made. If the service performed is so valuable that it can be dispensed with only at considerable inconvenience or economic loss the obvious expedient is to install a substitute or spare machine to operate if and when the first machine is unavailable.

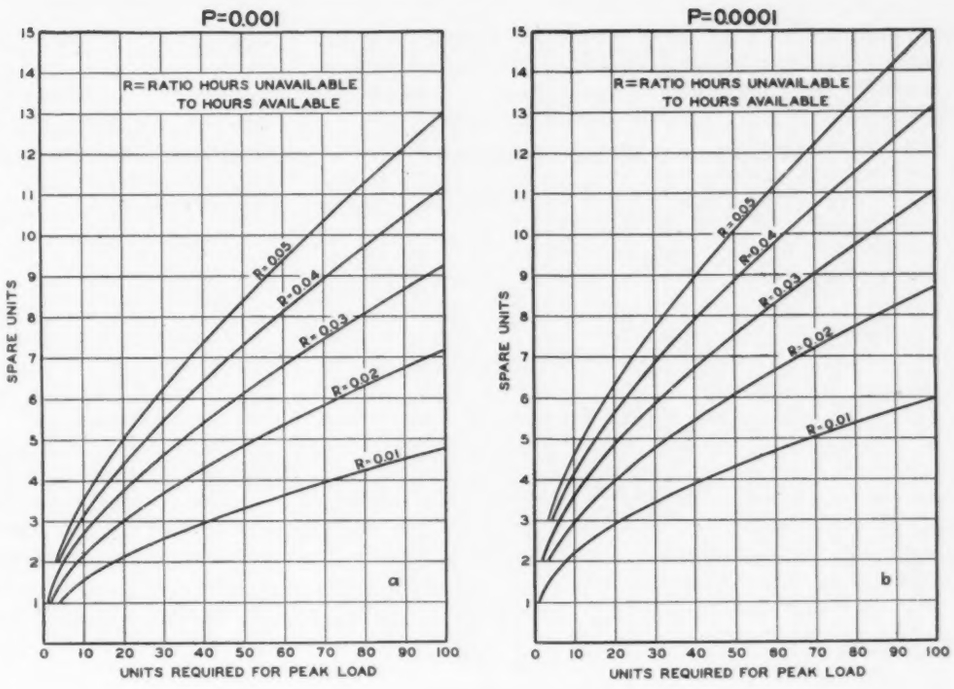
If the apparatus be a boiler, turbine, generator, transformer or other piece of equipment employed in the generation or distribution of electrical energy its function is of such importance that almost invariably it must have a spare ready to carry on when the emergency arises. In some cases, where the equipment is complex and inherently subject to frequent interruption, it may be necessary to provide more than one spare unit—perhaps two or three, or even more.

In practice the answer to the question of how much spare to install is usually provided by some rule of thumb or "policy," based to a degree on actual experience, but more often founded on some tradition, the origin of which is obscure or forgotten. Time-honored rules of this sort, while seemingly satisfactory, are frequently grossly illogical and lead in some instances to the provision of insufficient spare capacity, and in other cases to the installation of far more reserve than is necessary. For example, in the matter of substation supply cables it is the practice of some power companies to install as many cables as the predicted peak load demands plus one cable to serve as spare for the others. A study of the load duration curve, together with an analysis of the probabilities of cable failure, will usually reveal that where one cable is needed for load and one is installed as spare the reliability of service is distinctly inferior to that of the case in which, say, five cables are required for load and one spare is provided. Actually one regular cable plus two spares may be more nearly comparable in reliability to five regular cables plus one spare.

Fixed percentage fallacious

In the case of generating capacity, to cite another rule, it is sometimes customary to provide a fixed percentage of reserve capacity without due regard to the number of units installed. As the system grows can this percentage be reduced? If so, by how much can it be reduced without impairing the quality of service rendered?

In considering the application of probability theory to problems of power system spare capacity it will be important to differentiate at the outset between two general causes which may result in interruption to service. The first of these is due to the chance coincidence of a number of unrelated events, such as the random and independent failures of a number of generating units. Against load loss resulting from occurrences of this kind spare units can provide any degree of insurance desired. From a knowledge of the frequency of troubles



Higher degree of service availability demands more spares

Spare units for higher degree (a), 9,999 hours in 10,000, only slightly more for large systems than for (b), 999 hours in 1,000.

besetting the individual unit, the expected number and extent of these coincidental occurrences can be definitely calculated, and by varying the number of spares the expected interruption to service can be made as great or as small as may be desired. The second cause is some widespread unpredictable catastrophe which may disable an entire generating station or even an entire system. The occasion may be earthquake, war, strike, sabotage, or the like. In such emergencies the mere multiplicity of generating units or even generating stations may be of little or no avail in avoiding loss of load.

Controlling the degrees of uncertainty

In thinking of these two causes a simple analogy may be useful. If one were concerned with securing a dozen fresh eggs from a nearby store, and if the stock from which the eggs were to be obtained ran a certain percentage bad, it would be prudent to purchase a few eggs over the dozen required so that it would be very nearly certain when the eggs were opened that the requisite number of good ones would be found. The expression "very nearly certain" is used because it is of course not theoretically possible to attain absolute certainty, although by increasing the number of extra or spare eggs certainty may be approached as closely as may be desired. If, on the other hand, the probability of failing to secure the dozen eggs arises not because some of the eggs may be bad, but because the bottom may fall out of the basket in which the eggs are carried, then it will do no good to purchase extra eggs, because if the basket fails fifteen or twenty eggs can break as readily as twelve.

It is with the first type of cause that probability theory has its most useful application. With the second type it can deal less readily, because the data on which calculations must depend are so difficult to determine. Mathematics can be of much greater help in predicting the number of bad eggs, or the number of generating units which may be simultaneously unavailable, than it can in attempting to determine the expected number of earthquakes or defective baskets.

Spare Units Required Depends on Permissible Outages

Units Required for Peak Load	Probability of Load Outage at Peak = 0.001					Probability of Load Outage at Peak = 0.0001				
	R = 0.01	0.02	0.03	0.04	0.05	R = 0.01	0.02	0.03	0.04	0.05
2	1	1	2	2	2	2	2	2	3	3
4	1	2	2	2	3	2	3	3	3	4
6	2	2	2	3	3	2	3	3	4	4
8	2	2	3	3	3	2	3	4	4	5
10	2	3	3	3	4	3	3	4	4	5
15	2	3	4	4	5	3	4	5	5	6
20	3	3	4	5	5	3	4	5	6	7
25	3	4	5	5	6	4	5	6	7	7
30	3	4	5	6	7	4	5	6	7	8
35	3	4	5	6	7	4	6	7	8	9
40	3	5	6	7	8	4	6	7	8	9
45	4	5	6	7	8	5	6	8	9	10
50	4	5	7	8	9	5	6	8	9	10
60	4	6	7	9	10	5	7	9	10	12
70	4	6	8	9	11	5	8	9	11	13
80	5	7	8	10	12	6	8	10	12	14
90	5	7	9	11	13	6	9	11	13	15
100	5	8	10	12	13	6	9	11	13	16

R = ratio of hours unavailable to hours available.

Expectation and probability

It will be well at this point to give certain explanations and definitions of terms which have already been used in their general meanings, but which will be used later in a more technical sense. The dictionary definition of *probability* is given as "the ratio of the chances favoring an event to the total number of chances for and against it." Another, the so-called frequency definition, may be stated thus: "If a large number of trials be made under the same essential conditions, the ratio of the number of trials in which a certain event happens to the total number of trials will approach a limit, and this limit is the probability that the event will happen." Thus the probability that a certain machine will be unavailable is practically the ratio of the number of hours of unavailability to the total number of hours in service (both available and unavailable) when the service period is a very long period of time.

Mathematicians go into lengthy philosophical discourse on the meaning of probability, but for the present purposes the conception which either of the above definitions gives will suffice. In any case it is evident that the measure of probability is some fraction lying between zero and unity, zero representing impossibility and unity denoting certainty. Another term is *expectation,* which is the product of probability and the number

of trials, or of probability and time. Thus, if under certain conditions the *probability* of load outage is 1/1,000, the expectation of load outage in a period of 50 hours is (0.001) (50) = 0.05 hours.

Two parts to the spare problem

The problem of how much spare capacity to provide resolves itself into two distinct parts:

First, how reliable shall the service be? What expectation of load outage in a year shall be deemed satisfactory? Perfect service can never theoretically be attained; it can only be approached. Regardless of how much spare is provided, there remains a certain probability of simultaneous failure of enough equipment to cause load outage, and this probability, no matter how infinitesimal, multiplied by the period under consideration gives a certain expectation of outage. This may amount to an hour in a year or a second in a century, but it cannot be reduced to absolute zero. Much might be written on what this expectation should be, based on economic or other considerations, and on methods, rational or otherwise, of arriving at its value. While it is not within the province of this article to discuss this part of the question in detail, the desirability of determining such a value to be set up as a standard of service reliability should be emphasized.

Secondly, once this standard has been agreed upon, the system should be engineered to meet it. From the coal pile to the customer's meter exists a series of apparatus, a kind of chain, each link of which may at times fail. The sum of the outage expectations of each of these links must be made equal to the outage expectation set up for the system as a whole. Suppose (simply for illustration) it were agreed that an average outage per customer of twenty minutes per year was permissible. Two of these minutes might be assigned to the generating system. On this assumption, the procedure in an existing system would be to make a probability study of the generating units to determine whether or not the expectation of outage met this figure. If it exceeded two minutes, additional spare would be needed; if it fell below two minutes, it might be desirable to shut down or even retire certain equipment.

Typical station problem analyzed

In presenting an example of the application of the theory of probability to power systems it will be advantageous to start with a rather simple problem. The one chosen is the determination of the number of spare generating units required in a hypothetical system. By means of a number of assumptions, stated or implied, the problem may be stripped of many complicating practical considerations, thus permitting a more ready exposition of the essential principles underlying the solution. When the basic theory is understood in a simple example, it is then not difficult to apply it to more complicated problems.

Consider a system of five interconnected generating units of uniform capacity and all running whenever available, the aggregate capacity of four of the units being equal to the peak load. The units are assumed to be subject to emergency outages amounting to an average of 3 per cent of their service hours. Thus it can be stated that the probability of finding, at any time, any particular unit unavailable is $\frac{3}{100+3}$. The numerator represents the "chances" favoring a condition of outage and the denominator the "chances" for and against this condition. This is in accordance with the first of the foregoing definitions of probability. By the same token, the probability of finding any particular unit available is $\frac{100}{100+3}$. The former probability will be called p; the latter, or complementary probability, will be denoted as q.

What is the probability that all five of the units will be simultaneously unavailable, assuming that causes of failure are individually at random? That the answer to this is p^5 scarcely needs demonstration. Similarly, the probability that all five units will be simultaneously available is q^5. The probability that some one particular unit out of the five will be unavailable and the remaining four available is evidently pq^4. The probability that any one of the five units will be unavailable while the remaining four are available is $5\ pq^4$, because this condition is equally probable with respect to any of the five units. The probability that any two units will be unavailable and the other three available is $10\ p^2q^3$, since there are ten equally probable combinations that can be formed out of five units taking two at a time. The following table can now be set up to show all the possibilities:

Number of Units Simultaneously Unavailable	Probability Expression	Probability Evaluation
5	p^5	0.00000002
4	$5p^4q$	0.00000349
3	$10p^3q^2$	0.00023290
2	$10p^2q^3$	0.00776348
1	$5pq^4$	0.12939132
0	q^5	0.86260879
	Total =	1.00000000

It is interesting to note and useful to remember that the probability expressions in the table are just the terms which would have been obtained by expanding the binomial $(p+q)^n$, where in this case $n = 5$. Since $(p+q)$ must always equal unity, any power of $(p+q)$ also equals unity; thus a check is had on the accuracy of the computational work.

Extra unit economically reduces risk

In this hypothetical system interruption to service will occur whenever two or more units are out of service, the probability of which is the sum of the first four terms in the binomial expansion, or 0.00799989, say, 0.008. In other words, out of 1,000 hours of system operation the expectation is that for eight hours there will be simultaneously out of service two, three, four or five units. This would probably not be regarded as satisfactory service.

If a second running spare is added to the system and the first four terms of the expansion of $(p+q)^6$ are evaluated it is found that the outage expectation is reduced from eight hours in 1,000 to less than one-half hour in the same period. If a third running spare is added the expectation of load outage shrinks to a little over a minute in 1,000 hours.

It is, of course, true that a load outage due to the simultaneous unavailability of units does not necessarily mean that all load will be dropped. In fact, the overwhelming majority of such outages should affect only a portion of the load. As the table indicates, the prob-

ability of losing all the load through the random outage of all five units is represented by the extremely small value 0.00000002.

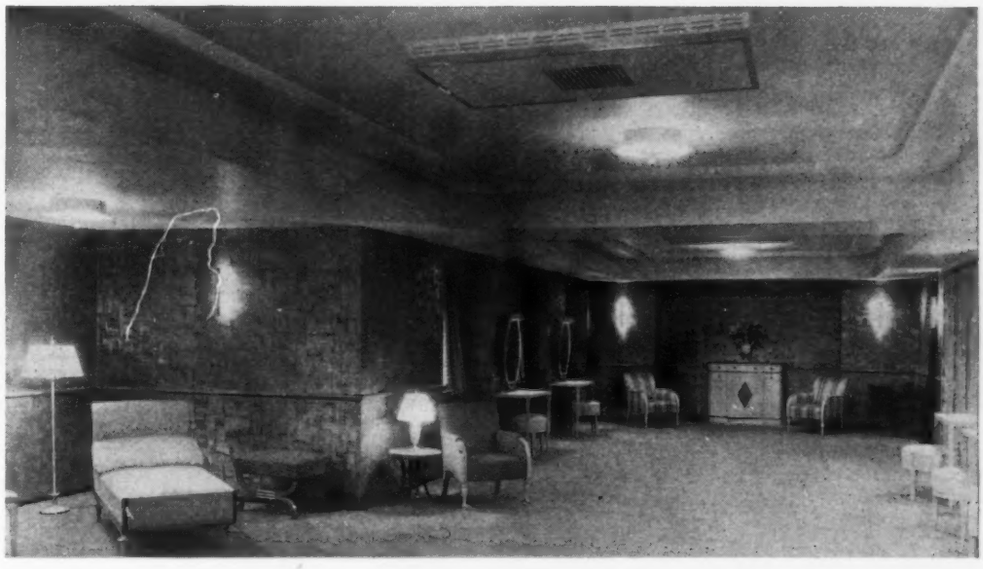
Using the method just illustrated, a large number of calculations have been made, from which have been drawn the curves shown in the figure. The curves in (a) show for several values of the ratio of emergency outage hours to service hours, and for various numbers of machines of uniform capacity required for peak load the number of additional machines which must be run as spares to obtain a probability of load outage at the time of the peak of 0.001; that is, an expectation of one hour's load outage in 1,000 hours of peak-load operation. The curves in (b) are calculated for a load outage probability at the time of the peak of 0.0001. This information is presented in tabular form in the accompanying table, the spare machines required for various conditions being shown as integral numbers.

Less spare needed with interconnection

It is, or at least should be, well recognized, either intuitively or through actual experience, that as the number of generating units in a system increases with growth in load, or due to interconnection with other systems, the percentage spare capacity can be decreased without sacrifice of service reliability. The curves and table presented illustrate, for units of uniform size, the mathematical evaluation of this effect. For example, when the ratio of time unavailable to time available is 0.03 and an outage probability of not more than 0.001 at the peak is desired, a system having load for two units requires 100 per cent spare, whereas 30 per cent spare is sufficient in a system having load for ten machines, and 10 per cent is enough reserve for 100 units. Under the same assumptions, a system in which twenty machines are installed for load calls for four machines as spare. If two such systems are interconnected, with load for 40 machines (assuming no load diversity), by virtue of interconnection alone the same probability of load outage can be had with six spares for the combined system, resulting in a saving of two units. The saving is greater if a probability of 0.0001 instead of 0.001 is assumed, as can be seen from a study of the table which appears on page 223.

Modern Lighting and Air Conditioning

By A. L. POWELL
Supervising Engineer
Incandescent Lamp Department
General Electric Company



In this ladies' waiting room connected with the new National Broacasting Company's studios we do not find the conventional ceiling chandeliers. Instead there are a series of drum-shaped fixtures close to the ceiling. These consist of a metal ring about 4 in. deep covered with a glass-diffusing disk of slightly larger diameter. This is held in place by an attractive metal ornament. Within are two 75-watt "Mazda" lamps.

The ceiling is finished in dark cream and the walls covered with salubra in green, silver and brown. The woodwork is silver-gray harewood. On the side walls are a series of luminaires in the form of copper tubes approximately 18 in. long. The rear section of these is cut away. At the center of the tube is a double socket which serves two 25-watt tubular lamps. Their light is directed against the wall, giving an indirect effect. Over each dressing table mirror, which in spirit carries out the modernized Empire note, is a metal reflector with a 25-watt lamp. A homelike touch is given through several floor and table lamps. Cox, Nostrand & Gunnison are responsible for the design and manufacture of the lighting equipment.

On the ceiling will be noted a series of square shallow boxes. These are painted and further ornamented by a band decoration in bright metal. Circulation from the air-conditioning system takes place through the bottom grille and side openings of this box. Air-conditioning devices of a commercial type are decidedly out of place in this sort of room, but here is a design which is in no way objectionable and actually becomes an ornament.

Fast Reclosing Service at Lower Cost

By W. L. GARLINGTON
Engineering Division, Florida Power Corporation, St. Petersburg

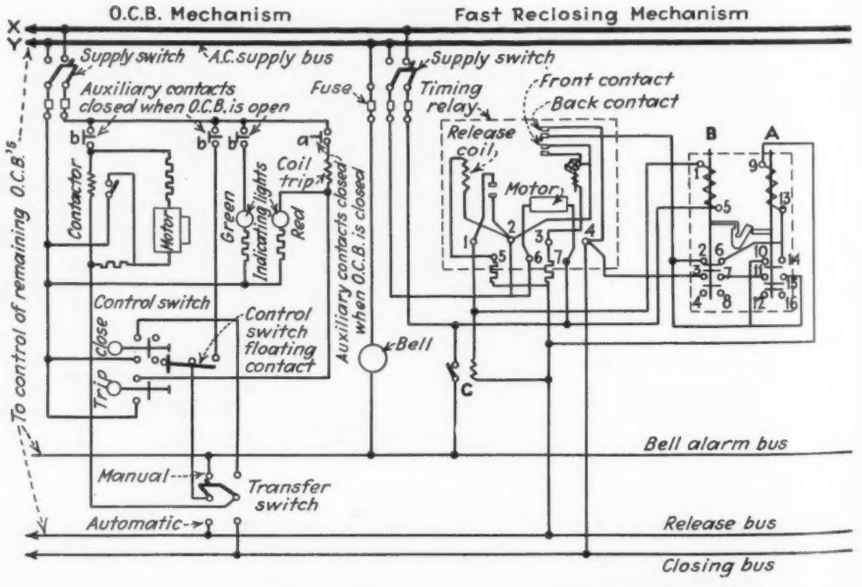
As a compromise between the super-service of reclosing distribution feeder breakers in less than one second and the relatively high cost of that refinement various expedients are available. Two control plans, each using a motor-operated timer, have been notably successful, with economy, on one property.

RECLOSING of distribution feeder breakers can be speeded up to less than one second by the use of additional relays on existing reclosing equipment. However, on many feeders of low earning capacity it is difficult to justify the expenditure of additional capital to obtain fast reclosing. There is no saving in operating expense and no addition to revenue is obtained except where the outage would otherwise have resulted in lengthy delays in the customer getting his equipment back into full operation after the interruption. Whatever is spent must usually be justified by the better service that is given the customer.

At substations having more than one reclosing breaker the installation can usually be made with no increase in total cost of equipment by arranging a single installation of fast reclosing relays so that it will be switched automatically to the breaker on the faulted or overloaded feeder. This arrangement makes possible the release of all but one of the existing timing relays that had been originally provided for each breaker.

In both schemes shown, the automatic control of all reclosing breakers at a substation is placed on one set of reclosing equipment, consisting of one of the existing timing relays and the additional contactors required to obtain a fast first reclosure. Transfer switches on each

Scheme 1, using motor-operated timer with contact arms



1. Relays *A* and *B* are interlocked so that *B* can be dropped out only by energizing *A*. *B* can be reset to its operating position only by energizing its own coil.

2. The timing relay is adjusted so that the front contacts are closed with the rotating disk in the starting position. The first arm on the rotating disk of the timing relay is altered so that the rear contacts are not closed by it.

3. When a breaker trips with the control switch in the closed position and the transfer switch in the automatic position the coil of *A* is energized through the release bus, which has been energized by the closing of an auxiliary contact on the tripped breaker. *A* picks up and seals itself in through contacts 10 and 14, at the same time dropping out *B*. The closing bus is energized through contacts 3 and 7 of *B* and 11 and 15 of *A*, thus providing circuit for the control relay of the tripped breaker, which closes instantly.

4. Upon tripping of the breaker as described above, the release coil of the timing relay is energized and the motor allowed to rotate. No reclosure is made by the first arm on the rotating disk, this reclosure being provided by the fast reclosing relays.

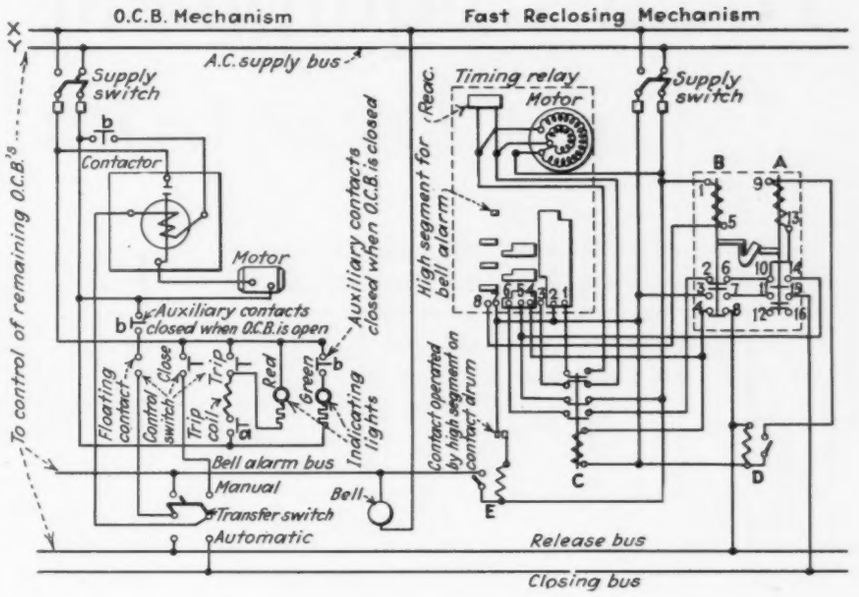
5. The motor of the timing relay continues to rotate and if overcurrent conditions persist the second arm on the rotating disk closes the front pair of contacts on the timer, energizing its auxiliary relay, which closes and seals itself in. After a short time interval the second arm closes the rear pair of contacts, providing circuit for the control relay of the tripped breaker, which recloses for the second time.

6. The timer motor continues to rotate and if overcurrent conditions persist the breaker is closed once more by the action of each remaining arm of the timer. If the breaker is open after the last arm passes over the main contacts of the timer the release coil is energized and the stop on its plunger engages the locking-out arm on the main shaft so that the disk is prevented from turning, thus locking out the timer.

7. In case overcurrent disappears before the last arm passes over the main contacts of the timer the release coil is de-energized and the stop on its plunger does not engage the locking out arm, but allows the disk to complete its cycle and then engages the service arm on the main shaft. After the last arm passes the main contacts of the timer the bell alarm contacts close, providing circuit through the coil of *B*, which resets. The equipment is then ready for an entirely new sequence of operations.

8. In case the timer locks out, the bell alarm contacts remain closed. The release bus is also energized through the tripped OCB, which provides circuit for closing bell alarm relay *C*, which completes circuit through bell to sound alarm.

Scheme 2, using motor-operated timer with reversible drum



1. Relays *A* and *B* are interlocked so that *B* can be dropped out only by energizing *A*. *B* can be reset to its operative position only by energizing its own coil.

2. The reversible drum-timing relay has its contact bars set as follows: In the normal starting position contacts 4, 5 and 6 are interconnected. Contact 6 clears the contact bar an appreciable time before contacts 4 and 5. Contacts 7 and 8 close before contacts 5 and 6 open. The above arrangement of contact bars is duplicated for each additional reclosure desired. Where bell alarm installations exist an auxiliary contact is mounted on contact 7. This contact is closed by a high segment on the revolving drum when the lockout position is reached.

3. When a breaker trips with the control switch in the closed position and the transfer switch in the automatic position the coils of *C* and *D* are energized through an auxiliary contact on the tripped OCB, the release bus, and contacts 4 and 8 of *B*. When *C* and *D* pick up, the coil of *A* is energized through *C*, *D* and contacts 2 and 6 on *B*. *A* picks up, drops out contactor *B* and seals itself in through its own contacts 10 and 14. This completes the circuit to the closing bus through contacts 3 and 7 of *B* and 11 and 15 of *A*. The closing bus energizes the control relay of the tripped breaker, which closes instantly.

4. The motor of the timing relay commenced to rotate forward upon the picking up of *C* as decribed above, and continues to do so until contacts 4 and 5 are broken. Contacts 7 and 8 close before forward rotation ceases, providing circuit for resetting *B*. The timing relay is then ready for another reclosure.

5. If overcurrent conditions persist the coil of *C* remains energized through contacts 4 and 8 of *B* after contacts 4 and 5 of the timing relay are broken, causing the timing relay to continue to rotate forward until contacts 4, 5 and 6 close a second time. *A* picks up as before, drops out *B*, thus providing circuit for the control relay, which recloses the OCB for the second time.

6. The timing relay continues to rotate (forward if overcurrent positions persist) and recloses the OCB one more time for each additional set of contact bars across 4, 5 and 6, and 7 and 8. If after any reclosure the breaker remains closed, the motor reverses and resets the timer. The equipment is then ready for an entirely new sequence of operations.

7. If overcurrent conditions persist after the last reclosure the timer continues to rotate forward to the lockout position. At this position a high segment on the drum closes the contact mounted above contact 5, which picks up *E* and rings bell alarm. The timer will automatically reset upon closing the locked-out breaker by manual control or upon removing the transfer switch from the automatic position.

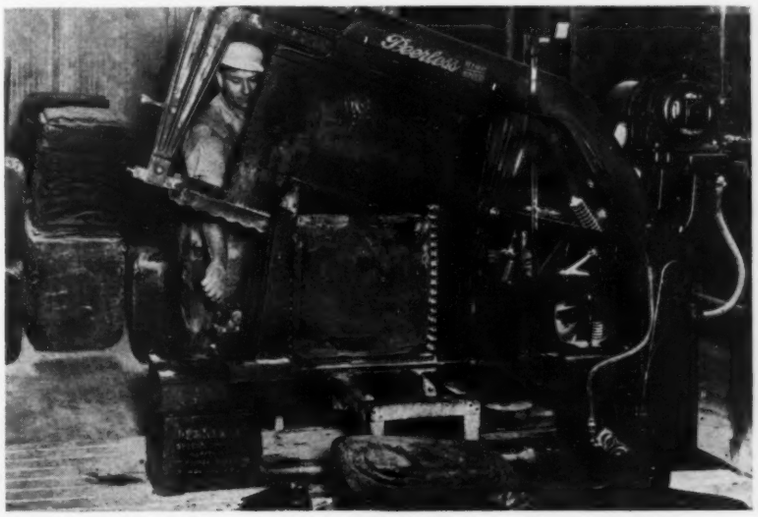
8. Pumping of the OCB is prevented by *A*, which drops out each time the breaker is closed. It is then necessary for contacts 7 and 8 of the timing relay to reset *B* before another automatic reclosure is possible.

breaker control panel make it possible to operate any breaker on either manual or automatic reclosing. In operation the fast reclosing equipment shortens the time required for the first reclosure to a minimum, but does not affect succeeding reclosures provided by the timing relay.

Placing the automatic reclosing of all breakers on one reclosing relay mechanism has not proved objectionable, as the reclosing equipment, whether provided for each breaker or a group of breakers, almost immediately receives attention after being locked out by a persistent fault on any feeder.

A Little Motor on a Big Job

Ever try to cut rubber with a knife? Not at all like cutting butter, is it? But here's a little 2-hp. motor that slices slabs off bales of raw rubber for the Cupples Rubber Company, St. Louis, Mo., and doesn't make the least fuss about it.



Courtesy Union Electric Light & Power Company

Today's Equipment Eliminates Hazards of

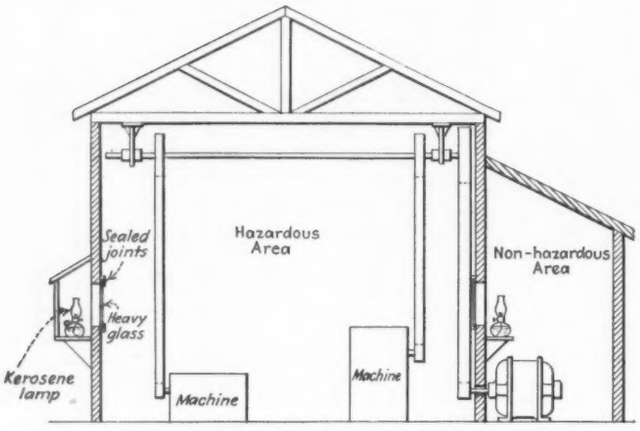
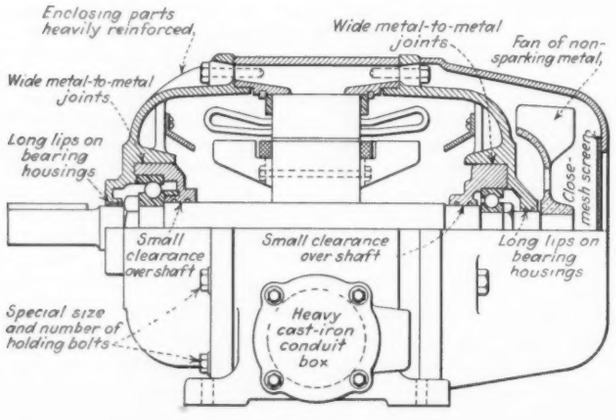


Fig. 1—Isolation was once the only way of curbing the explosion hazard

An early factory handling material giving off explosive vapors adopted effective but inefficient and inconvenient precautions.


Enclosing parts heavily reinforced
Wide metal-to-metal joints
Fan of non-sparking metal
Wide metal-to-metal joints
Long lips on bearing housings
Close-mesh screen
Small clearance over shaft
Small clearance over shaft
Long lips on bearing housings
Special size and number of holding bolts
Heavy cast-iron conduit box

IN THE constantly expanding fields of the manufacturing and chemical industries there have been developed many processes in which materials that give off vapors must be handled. Such vapors, when mixed with air, are capable of forming highly explosive gases. Since the beginning of the use of this class of materials the attendant hazard of explosion and fire has been recognized and the necessity for the use of precautionary measures to guard against this hazard has been appreciated.

The preliminary solution of the problem of eliminating explosions in plants in which explosive compounds were handled was naturally the complete isolation, in so far as was possible, of all sources of sparking or excessive heating from the building, or that part of the building in which such material was handled. As an illustration of this more primitive method of protection, a drawing (Fig. 1) shows a plant which came to the writer's attention many years ago. Effective? As a protection against explosive accidents, yes. On the other hand, far lacking in the present-day efficiency and convenience of a modern plant in which both motors and lights are installed wherever desired in the same manner as they would be installed in locations of a non-hazardous nature. The aim has, therefore, been toward the development of appliances and fittings that can be installed in hazardous areas which will, in themselves, combine all necessary protection against the transmission of ignition to any explosive gases that may be present.

The cause of accidental ignition may be due to normal causes, such as arcs from switches or other appliances used for the intentional breaking of circuits, or to accidental conditions, such as defective insulation, poor con-

Fig. 2 — Eight distinctive features mark explosion-proof motors

Class I, Group D, hazardous locations call for a motor with these features.

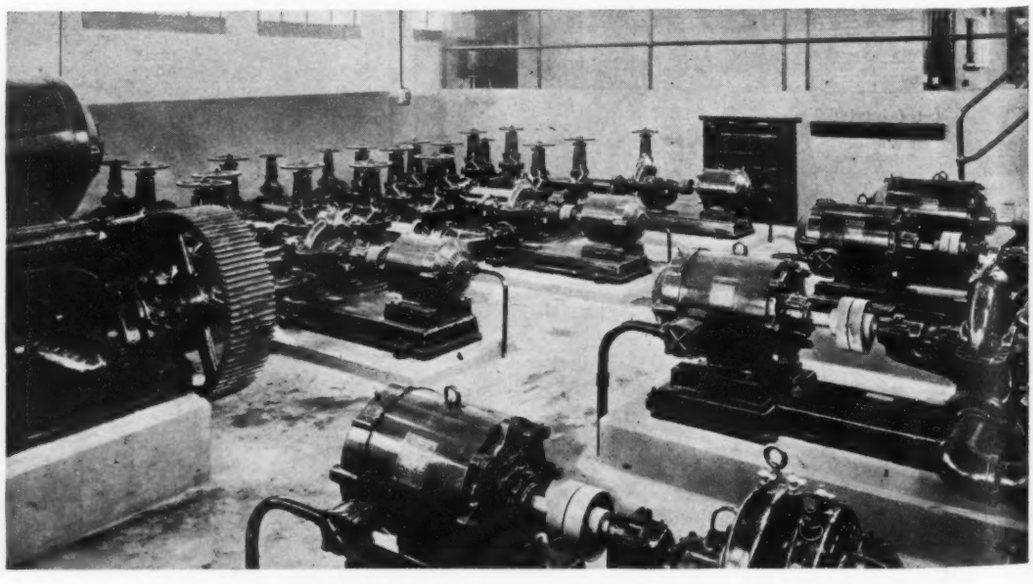


Fig. 3 — A battery of explosion-proof motors in a dangerous atmosphere

All lighting is also made explosion proof in this installation.

By GEORGE H. HALL
Consulting Engineer, New York

Explosive Atmospheres

In the progressive evolution from isolation of hazard to permissive character of equipment for the applications of electricity to operations in explosive and inflammable atmospheres much that was cumbersome has been eliminated; many improvements made.

Control of potential hazard as well as control of incurred risks has brought safety and service continuity.

An outline for greater safety and better service to industrial users of electrical energy.

nections, static discharges or overheating of motors and other appliances. It is therefore seen that the matter of installation of electric equipment in hazardous locations presents a problem that is inclusive. All types of material used, such as conduit, fittings, switches, motors and lighting fixtures, must be adapted to the special conditions obtaining in such localities as may be classified as hazardous.

Since the presence of as low as 1.4 per cent of gasoline vapor in the air of a room produces a mixture which will explode if ignited, all plants in which this vapor is present are naturally considered hazardous. Ethyl ether, ethylene, methyl chloride and similar vapors if mixed with air in slightly greater proportions than gasoline will also render the atmosphere explosive. It is also a well-known fact that the presence of impalpable dust in the atmosphere produces an explosive mixture, as the more or less frequent blowing up of coal-working plants and grain storehouses bears evidence. Yet it is readily appreciated that vapor-ladened air and air charged with dust present widely different problems of hazard and that each must be handled by methods best adapted to the particular conditions existing.

Hazardous locations classified

For the purpose of clarifying the situation and enabling the manufacturers of electrical apparatus to suit their material to the varying conditions that may exist, the Underwriters' Laboratories have given us the following classification of hazardous conditions. These are divided into four classes: Class I covers atmospheres containing vapors or gases, while Class II covers atmospheres containing dust. Classes III and IV cover locations in which easily combustible material is handled, manufactured, used or stored. These two classes deal with materials in the air which are readily ignited by the electrical spark, but which, when ignited, although producing fire, do not cause explosions.

Under each of the explosive classes there are further groupings, depending on the character of the vapor or dust that is contained in the atmosphere in which the apparatus is to be used. Thus:

Class I, group A, atmospheres containing acetylene; group B, hydrogen; group C, ethyl ether vapor; group D, gasoline, common petroleum, ethyl alcohol, methyl alcohol, acetone and lacquer solvent vapors.

Class II, group E, atmospheres containing metal dust; group F, carbon black, coal or coke dust; group G, grain dust.

Of the various classes as above outlined the conditions covered by Class I, group D, are the most generally encountered. This class covers such common installations as are found in alcohol, chemical, dry-cleaning, enameling and gasoline plants, also paint factories, garages, gasoline handling and filling stations. Consequently the demand for apparatus to comply with the requirements of this class of service has been so great that more attention has been paid to the standardization of apparatus for this than for any of the other classes. Under certain conditions apparatus suited to Class I, group D conditions may be applicable for some of the other classes and groups, such as Class II, group G, but in general apparatus designed for any particular class or group should not be used for installations coming under any other class or group without approval of the Board of Underwriters.

It is the purpose of the present article to confine our attention to material suited for use under Class I, group D conditions alone.

Early attempts to provide against hazard due to the presence of explosive gases or vapors contemplated the use of apparatus that would keep the gas out of the cases in which current was broken or live parts contained. This proved impracticable as vapors will in time penetrate the most carefully constructed inclosure, either through the joints or by "breathing" of the conduit system. The method that has now been adopted is so to construct all parts of the installation that repeated explosions may take place without interfering with their operation and without permitting any gas or flame to escape. This apparatus must be so designed that the temperature of the exposed or external surfaces will never become sufficiently high to ignite the vapor-charged or hazardous atmosphere.

As a further precaution, against insulation failure as well as against static charges, the conduit system and all apparatus used in a hazardous area must be thoroughly grounded in accordance with the rulings of the National Electrical Code.

Apparatus designed to meet the conditions of this class of service is naturally more expensive than that for use in ordinary locations. It is therefore customary, in plants where hazardous conditions exist, to segregate as far as possible the hazardous from the non-hazardous areas. In general practice entrance switches for the system

serving the hazardous section will be installed in an adjacent non-hazardous section and all wiring from this switch into the hazardous area will be of the explosion-resisting type.

Wiring equipment safeguarded

For installation in hazardous areas rigid conduit with threaded joints is the only system allowed by the National Electrical Code. In the use of threaded joints it is necessary that the pipe enter the box or coupling to the extent of five full machine or pipe threads in order to make an acceptable flame-proof joint.

Since this type of equipment contemplates that there will be normal sparking at switches, circuit breakers, and wherever current is intentionally broken, the entire system should be sectionalized so that an explosion occurring at any point will not be transmitted through the system. This is accomplished by the use of sealing condulets which may be introduced at frequent intervals throughout the conduit run. There is a twofold reason for this: First, the farther that an explosion extends, the greater are the chances of finding a flame path or opening to the outside atmosphere, or of a weak place in the conduit system; second, a phenomenon known as "pressure piling" may produce an explosive pressure greater than the conduit system will withstand. "Pressure piling" may occur from an explosion at one end of a conduit, driving the unignited gas ahead of it and producing an initial compression before ignition takes place.

Arcing devices such as switches, circuit breakers or control apparatus should be isolated by sealing all conduits leading into or out of them. The sealing should be done close to the device so as to avoid "pressure piling." Conduit runs should be sectionalized every 50 or 100 ft., and also where they enter or leave a hazardous area.

Outlet boxes, junction boxes, switch cases, etc., are constructed to withstand the maximum pressures that may occur within them with a factor of safety of five. When tested hydraulically, in the process of manufacture, a safety factor of four is allowed.

Gaskets are not used, but all flat surfaces have carefully machined fits of not less than $\frac{1}{4}$ in. in width which may be increased up to 1 in., depending upon the length of joint. Whenever a rotating shaft passes through a box or fitting it is given a close running fit and the length of the bearing is depended upon to inhibit the escape of flame. The minimum length of such a bearing must be at least 1 in. Outlet and junction boxes are provided with screw caps having sufficient length of thread to provide explosion-proof joints.

While the code permits the use of fuses if installed in explosion-resisting inclosures, the necessity of removing covers for access to and replacement of blown fuses renders it far more convenient to employ circuit breakers in the place of fused switches. These may be manually or magnetically operated. In the larger sizes they are generally of the oil-immersed type, while for the smaller sizes the air-break type is usually satisfactory. Such breakers are provided with thermal overload protection and may be used in place of the ordinary fused switch for both power and lighting circuits.

Lighting equipment also explosion proof

Explosion-resisting distribution panels for the control of lighting circuits consist of a wired assembly of thermal overload circuit breakers, all contained in a cast metal cabinet together with a wiring compartment. Inlets for the mains are provided at both top and bottom, while the outlet compartment, usually at the top of the panel, is supplied with a number of outlets, those not in use being closed by plugs. Each circuit breaker is inclosed in its separate compartment and is usually suited to a capacity of

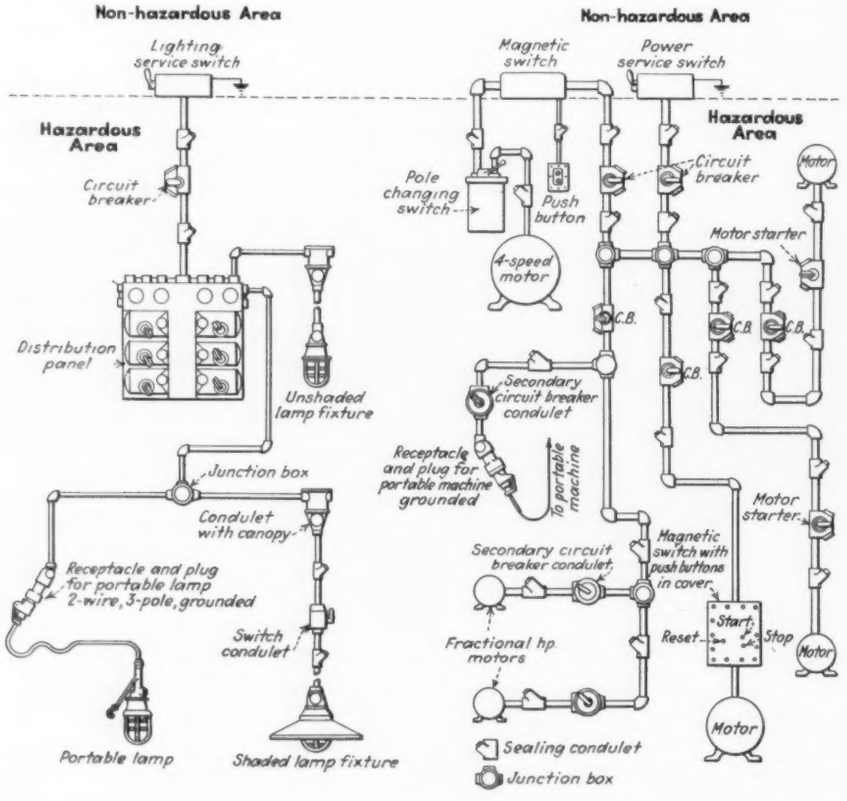


Fig. 4—Light and power wiring fixtures devised for explosion hazard

Fig. 5 — Explosion-proof air circuit breaker has all live parts inclosed from explosive atmosphere

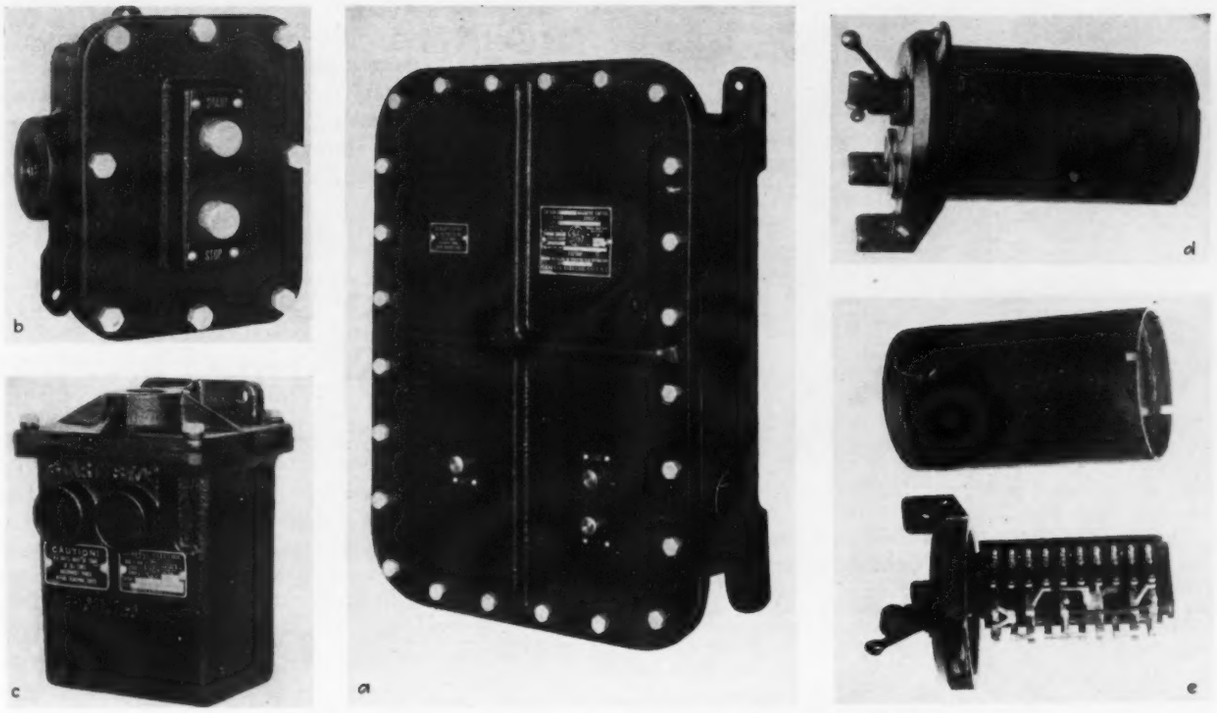


Fig. 6—Variety of control apparatus for dangerous locations

(a) Magnetic starting switch; (b) push-button station (air break); (c) push-button station (oil immersed); (d) and (e) four-speed drum controller, with and without cover.

15 amp., although breakers up to 35 amp. can be used in this type of panel if desired. The individual circuits are each controlled by external, indicating handles properly marked for "on," "tripped" and "off" positions. For the control of individual lights, tumbler switches are inclosed in explosion-resisting cases provided with external-operating, indicating handles.

Much attention has necessarily been given to the development of explosion-resisting lamp fixtures to meet this class of service since, with ordinary fixtures, a broken lamp, a ground or a short circuit would be likely to result in an explosion. Approved fixtures must therefore follow the same lines of construction as other explosion-resisting devices; that is, they must be so designed that they will not communicate flames nor excessive heat to the surrounding atmosphere in case of an internal explosion. This requires that the walls, glass globe and its fastenings shall have sufficient strength to withstand any internal explosion and that the joints shall be sufficiently tight to prevent the escape of flame. The fixture must also operate at a safe temperature. Wire terminals are covered with sealing compound and the globe is provided with a rigid metal guard to protect it from external injury. With such fixtures the standard "Mazda" lamps may be used. Lamps cannot be of the pendant type unless supported rigidly by conduit hangers. Flexible pendant drops are not allowed under the conditions.

Power equipment of fully inclosed type

Motors for use in hazardous locations of this class require special coustruction to withstand the high pressure and service. They are of the fully inclosed, dustproof type, having heavily reinforced shields, adequate bolting and wide metal-to-metal joints. Ample ventilation is provided by the use of ventilating fans which

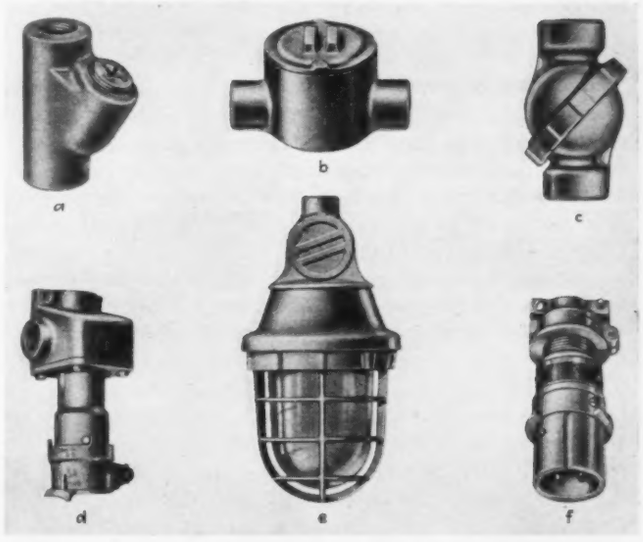


Fig. 7—Explosion-proof fittings for every purpose

(a) Sealing condulet; (b) junction condulet; (c) universal union; (d) receptacle for portable plug; (e) light fixture; (f) portable plug.

are made of non-sparking metal and shielded by a close mesh screen. The self-ventilation provides against the motor attaining any temperature high enough to ignite the surrounding explosive atmosphere, while small clearances over the shaft and long lips on the bearing housings prevent the escape of flames. Motors for this class of service must be provided with heavy conduit boxes with metal joint construction.

For the control of small motors, conduit switches similar to those used for lighting circuits in hazardous locations may be employed. For the larger motors explo-

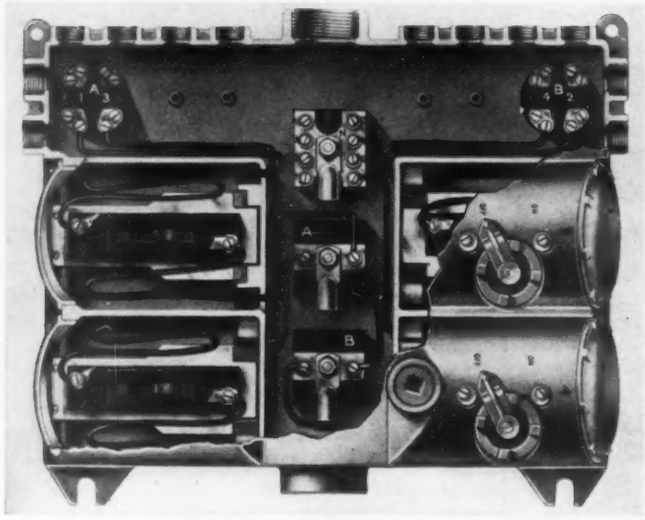


Fig. 8—All elements inclosed in a four-circuit explosion-proof lighting panel

Handholes give access to connection points. Circuits are always de-energized by an external breaker before work is done inside the panel structure.

sion-resisting, magnetic switches may be installed at any convenient points adjacent to the motors or, for the sake of economy, an ordinary magnetic starting switch may be placed in the non-hazardous area and only the push-button station, by which it is operated, located in the hazardous area near the motor.

Special plugs for portable equipment

Receptacles for use with portable lights or appliances, used in hazardous areas, must be so constructed that the attachment plug cannot be withdrawn while the current is on and all current-breaking parts must be inclosed in an explosion-resisting chamber. To remove the plug it is first necessary to withdraw it a sufficient distance to disconnect the current-carrying contacts. A collar or similar device, however, renders it impossible completely to withdraw the plug by this movement. This first partial withdrawal breaks the circuit, after which it is then necessary to rotate the collar or sleeve through a partial turn. This releases the plug, which may then be pulled out. The time required to make this adjustment is sufficient to allow the flame to cool before the arcing chamber is opened to the atmosphere. As soon as the plug is completely out of the receptacle a spring cover closes the opening so that no dirt or extraneous matter can come in contact with the current-breaking parts and thus cause a short circuit.

Should the portable cord be broken by undue strain it automatically pulls the plug out of the receptacle to the extent allowed by the first operation of removal. This breaks the circuit and immediately "kills" the cord, thus preventing any spark occurring in the hazardous area. At the same time the release collar prevents the plug from being entirely pulled out.

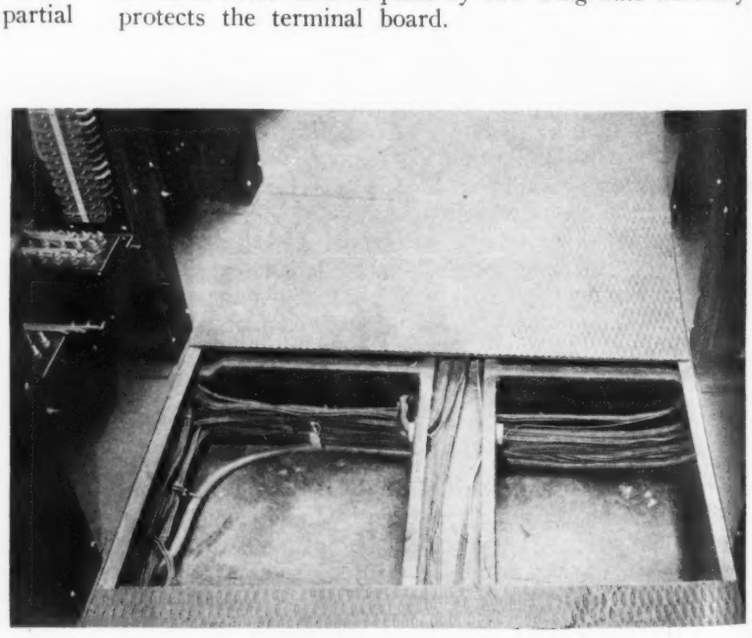
For photographs and data used in the preparation of this article acknowledgment is made to Crouse-Hinds Company, Cutler-Hammer, Inc., General Electric Company, Westinghouse Electric & Manufacturing Company.

Protected But Accessible Control Wiring Developed

Ready accessibility for inspection or future changes, ease of identification, protection from injury and isolation from unrelated circuits are particularly needed in control-circuit wiring if the troubles that may occur with the nerves of an electrical system are to be avoided or minimized. Some of the ways in which these requirements were met in the control room of the new generating station at Vernon, Calif., are shown by the accompanying illustration, taken in the walkway between its control and relay boards.

Below the metal floor panels is a recessed space, with transverse barriers that separate the control wiring of adjacent panels but permit connection of the two boards. Running along the center line of the recessed space is a metal channelway that isolates longitudinal connections from transverse wiring.

Circuits are carried up each panel in metal troughs formed by the U-shaped channels between adjacent panels. These have removable covers facing the walkway. On the side of each trough, mounted as close to the floor as possible, is a terminal strip, at which all incoming circuits terminate and from which connections are run up the trough and distributed at various levels to the panel equipment. The white circuit-identification strip, extending up the center of each terminal block, is attached to a hinged frame that can be swung out of the way when work on the connections is necessary. A metal cover held in place by two wing-nuts normally protects the terminal board.



Metal raceway isolates longitudinal connections from transverse wiring

LETTERS TO THE EDITOR

A Consumer Pleads for Personalized Service

To the Editor of the ELECTRICAL WORLD:

From long observation of the efforts of power companies to gain good will by enhancing their public relations and in the matter of giving the most excellent service to their residential customers, I have been struck with the fact that they apparently overlooked one of the best means to these ends.

Practically without exception, all the power companies of necessity maintain a meter department. The scope of this department may be either wide or narrow, depending on circumstances, but neither of these extremes would have anything to do necessarily with the attainment of the objectives referred to above. However, there is one thing that practically all companies do in common, and that is to maintain a force of strictly meter readers. The sole object of these men is to read and record in their books and report these readings. They may, of course, report other things, such as meters out of order or call attention to particularly low readings or high readings.

Speaking mainly now of the residential areas, where I think such a scheme as I have in mind will work on a practical basis, these meter men are sent out from headquarters and presumably have quite a large number of meters to read, that being their sole duty. In the course of a year the meter man has visited a residence twelve times. He has usually entered and exited through the back door or the cellar door, and for this reason has had to knock quite loudly and announce at the same time that he is the meter man. It happens frequently that the housewife or the maid has only just returned to her duties after having received other loud knocks from either the garbage man, ice man, milk man, or some other routine caller, and the meter man has, therefore, entered the residence immediately under two psychological difficulties:

1. That of being classified in the category of the other serving people.
2. That they know his coming is a forerunner of a bill for the electric service.

He presents himself in uniform, probably with high boots, or, rather, with puttees, brass button, etc., and of necessity, a conspicuous badge with his number and credentials on it. It is doubtful, during the period of a year, or probably five years, that if the same man called to read the meter he would be any better acquainted or the householder would know him except probably by sight, and even though he is courteous in every respect, he is probably told that his sole object is to go in, read the meter and get out.

It occurred to me that this is not right. The meter man, in the first place, should be above the standard of the garbage, ice, milk and baker man, and he should be of real assistance to the power company in every respect.

As practically all of the power companies conduct their readings in this way, there must be some very good reasons why they do so, and the above outline of my impression of the meter man and the psychology of his visit may be all wet, analyzed from the standpoint of operation by the power company. However, looking at it from the ordinary business point of view and with apologies for such lack of knowledge of the reasons for the meter readings being conducted in the manner they are at present, my conception of a real set-up would be as follows:

1. Careful zoning of residential areas from the following angles: (a) Type of residence; (b) the most reasonable size zone that could be operated by one man under the plan as given below; (c) the relation of a zone to a physical set-up of a distribution system.
2. Selection from these zones of young men already connected with the company or from the graduating class of high schools or business administration courses, the selection being made on the following basis: (a) Residence within zone; (b) personality; (c) should be highly regarded in the neighborhood and have the respect of those who know him; (d) come from a respectable family; (e) should not be a high-pressure man; (f) should have ambition to get ahead and should, therefore, be willing to give a reasonable amount of time during the evenings of the week to study or instruction by some group set up by the company on such matters as the cost of producing electricity as differentiated from the cost of service, the policy of the company, its rate structure, etc.
3. The system could be put in use and the name of the representative in a particular zone given through means of an announcement or a pamphlet or otherwise with the bill.
4. The man on his first visit, instead of simply knocking at the back door and announcing meter man, would announce Mr. Blank of Bread Acres Power Company. He should be particularly courteous on his first visit and let it be known who he is representing.
5. After taking the meter reading, he could make duplicate copy of bill on the premises, leaving one with the householder. The householder could either pay him then or send check or pay in person if desired. This would give him an opportunity to explain any doubts in the customer's mind as to the billing or to investigate any seemingly high use of current, thus leaving the customer in a fully satisfied attitude. This would save the machinery of billing and certainly should show economies over the present method of meter reading and billing.
6. On subsequent meter reading visits he would have an opportunity to leave any pamphlets or data with respect to additional appliances or might have the opportunity of investigating some appliance which is not working satisfactorily and indicate where it could be repaired or how replaced. He could also show in this way, by pamphlet or otherwise, the difference between electricity and electric service. These pamphlets might indicate along simple lines such fact that while beef in Texas may sell for 1½ cents a pound on the hoof, it costs from 15 to 20 cents a pound in the butcher shop, for the reason that it had to be slaughtered, dressed, shipped and delivered, which is the same thing the power company is doing with electricity. Other similar illustrations could be drawn, and it could be brought out that unfortunately power cannot be stored like beef or other perishables, but must be generated and used immediately.
7. In the case of any trouble with service in the house, this man would be "Johnny-on-the-Spot." It would not only give him an opportunity to know what causes the trouble but to make whatever satisfactory explanation that may be necessary.

As this man continued to call in this manner, I would suspect that it would not be long before he would not only be one of the best public policy assets of the power company but would also be one of its best salesmen in the sense that he had secured the confidence of the consumer. He could much more easily approach the consumer in the sale of new appliances than could a strange representative of the company on a door-to-door canvass or any beautifully illustrated booklet describing how easy it was to use such and such electrical appliance.

F. W. SHACKELFORD.

Philadelphia, Pa.

THIS WEEK'S NEWS

Free Energy for Sales Campaign

REVOLUTIONARY rate adjustments for domestic, agricultural and commercial consumers to encourage immediate additional use of energy are provided for in an application filed with the California Railroad Commission by the San Joaquin Light & Power Corporation and the Midland Counties Public Service Company. The plan involves the free use for a two-month period of temporary surplus electricity. During this trial period, when customers are permitted practically unlimited use of energy, a co-operative all-industry sales compaign will be launched in the territory served by the companies in which every branch of the industry will be invited to participate. Every form of sales promotion and publicity will be used during this campaign to induce customers to purchase all types of appliances .

The application filed with the commission embodies new schedules based on a modified form of the Alabama plan, together with a proposal that for this two-month period, commencing with the April meter readings and ending with the June readings, domestic and commercial lighting consumers be given unlimited use of electricity for a monthly charge not to exceed the amount of the bills paid by them in March. For the same period agricultural power consumers will be given the right to use power in excess of that used by them in 1933 at half price for the excess used or, under certain conditions, at no additional cost.

Also effective June 1 will be a new special combination domestic rate applicable to single-family residences, including separately metered flats and apartments where the consumer has installed a standard electric range and a standard electric water heater.

Southern Sierras Power Company has developed a similar plan with somewhat stronger limitations on the amount of free energy. The Southern Sierras plan has been approved by the California Railroad Commission (page 239).

Middle West Hearings Open; Insull Must Leave Greece

At the opening hearing upon charges of collusion in the Middle West Utilities Company receivership in federal court in Chicago Samuel Insull, Sr., was at the same time denounced as "a cowardly crook" and extolled as "superbly courageous." Samuel A. Ettelson, formerly Corporation Counsel, who brought the original charges of collusion, scored the fugitive as "the biggest thief of modern times, building his fortune on other people's money, running his companies into the ground and hiding now in Greece, afraid to face the music."

On the other hand, Arthur Andersen, head of the accounting firm employed to audit the Middle West books, declared that Mr. Insull retained unlimited courage, business judgment and integrity. Mr. Andersen testified that after the Insull disaster had been threatening for several months the apprehensive New York bankers had established his accounting company as a kind of super-control in Insull affairs, with power to veto vouchers in all the companies.

Insull passport renewed

In the meantime, the United States government is exerting itself to close every international avenue of escape from Greece for Mr. Insull. Restoration of his passport while theoretically giving him freedom to move where he pleases, is actually considered a step in the direction of early extradition. Sudden ratification this week by the Senate of an extradition treaty with Turkey, which had been sent to that body ten years ago, together with an Albanian extradition compact ratified last week, leaves Greece surrounded with extraditable territory across which Mr. Insull cannot allegedly retreat.

Utilities Place Orders to Supply Pennsylvania

Contracts for major electrical equipment in excess of $1,250,000 were let last week by the Safe Harbor Water Power Corporation and the Pennsylvania Water & Power Company to supply electric power to the Pennsylvania Railroad electrification extension to Washington (ELECTRICAL WORLD, February 3, page 198). These two power companies and the Consolidated Gas, Electric Light & Power Company of Baltimore will supply electrical energy for the extension below the Susequehanna River and will spend in all for new equipment more than $5,000,000 before the railroad company's plans are completed.

The equipment contracts were divided equally between the General Electric Company and the Westinghouse Electric & Manufacturing Company and include a frequency changer of approximately 35,000 hp. rating and one of the largest single-phase hydro-electric generators to have been built in this country, 42,500 hp. in capacity.

Heating Engineers See Air Conditioning Era

General acceptance of present air-conditioning equipment as being economically feasible and satisfactory even for small dwellings, was voiced by engineers attending the annual convention of the American Society of Heating and Ventilating Engineers in New York this week. Their estimate of the importance of the future residential market for this type of equipment was indicated by the prominent place it occupied both in the convention sessions and at the International Heating and Ventilating Exposition, held coincidentally, where the latest improvements in the home air-conditioning field are stressed.

While no new developments were introduced at the exposition, a great variety of unit and central air conditioners were offered for home, office and store by both old and new producers of such equipment. Most heater companies now offer centralized standard equipment for humidity control and ventilating equipment, as well as heating, with cooling units available if desired. Concentration on the domestic market is promised.

Lower costs developing

Unit-type conditioners were dominant, as lending themselves most easily to old homes heated with steam or hot water. Single room units, however, are still in the neighborhood of $800 to $1,000 installed for the equivalent cooling of that produced by the melting of one ton of ice per day, with an operating cost in summer of 8 to 10 cents per hour. An optimistic note prevails for the development of centralized plants in all new homes at a cost of $250 per room within two or three years.

Recent announcements indicate two large New York stores, John Wanamaker and McCreery to have entered the active promotion, demonstration and sale of unit type air-conditioning equipment.

Electric Utility Workers Strike in Cuba

Electricity, gas, water and street car services throughout Cuba have been imperiled by a strike of employees of the Compania Cubana de Electricidad following the return of the properties to the company by President Mendieta. The properties had been seized by the Grau San Martin administration on January 14 to prevent interruption of service by a strike (ELECTRICAL WORLD, January 20, page 128). When the company's employees refused offers to meet their demands upon the company at a conference called by President Mendieta, he announced his intention of returning the properties, declaring that "the company is disposed to concede the workers' demands for the naming of new officials and other conditions. But in view of labor's uncompromising stand it is the duty of this government to turn the property over to its rightful owners.

"The government will not permit obstacles of this sort to be thrown in the way of its proper functions. The government has taken all necessary precautions for the protection of the properties of the company." When news of the transfer reached the employees about half of them walked out, including those at the substations, causing an interruption of service for three hours. Street cars stood idle, power in all suburbs was cut off as well as gas in the entire city.

Carrying out the administration's conviction that the public service must be operated at all costs, heavy military guards were placed at the power plants and main offices of the company.

Pinchot Attacks Utilities and State Commissions

Reverting to his familiar brand of diatribes and characterizing public utilities as natural monopolies requiring strict regulation in the public interest, Gov. Gifford Pinchot of Pennsylvania last week stated that the utilities as a whole in America have been overcharging the consumer $500,000,000 a year. "While they were reducing the salaries of their employees during the depression," he said, "some of them were increasing their charges and many of them were increasing their profits."

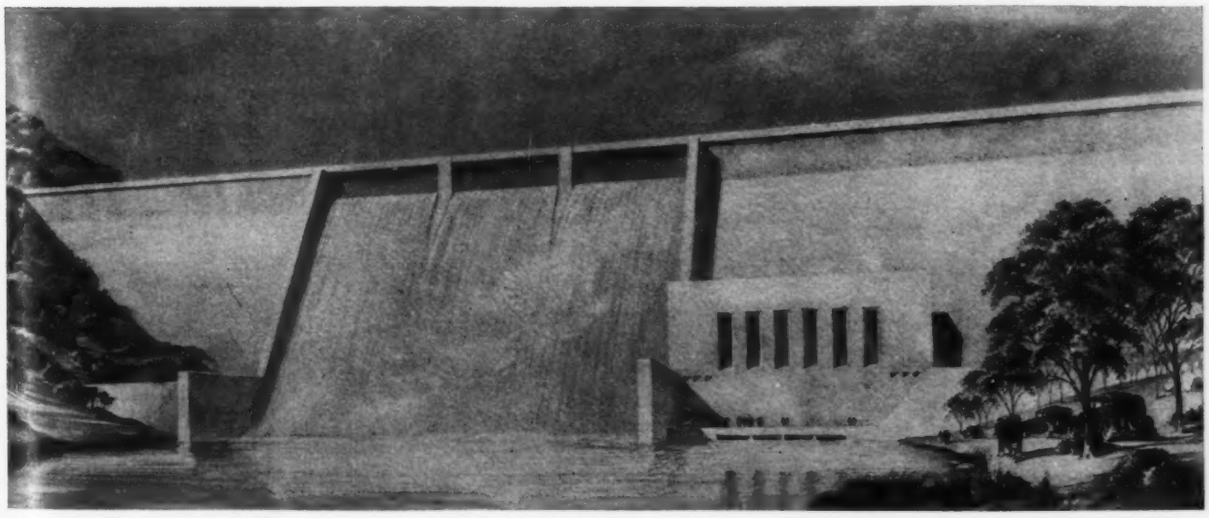
Public service commissions were severely criticised by Governor Pinchot as being controlled by the private companies. "The state public service commissions," he said, "were established ostensibly to help control the utilities in the public interest. As a matter of cold fact, from the beginning most of them were owned, controlled and operated by and for the benefit of the public service companies. The latter bought up legislators and legislative committees, and bought up public service commissions as well. If the utilities will not allow regulation to work they will force the state and federal governments to take over the gigantic electric monopoly and serve the people. . . . "

Trade Commission Hears Middle West Affiliate

Much ado over the relatively small allowance for obsolescence and depreciation made by utility companies following the retirement theory was made before the Federal Trade Commission in its examination last week of the Central & South West Utilities Company and subsidiaries.

Commission Examiner Carl H. Depue, testifying as to Central & Southwest's accounting methods, stated that for rate purposes the company had an allowance of 5 per cent with the Oklahoma State Commission for its subsidiary, Public Service Company of Oklahoma; with the United States Bureau of Internal Revenue it had an allowance of 3 per cent, but in its own published annual reports the allowance averaged 1 per cent on depreciable assets. Mr. Depue explained that this method is used to permit an overstatement of net earnings, payment of unearned dividends and inflation of the market value of all securities thus affected, including related holding companies. He added: "Such practices affect the consumers through inflation of the rate bases and affect present and prospective stock- and bond-holders by inflation of earnings, fixed capital and surplus." By mergers, refinancing and transfers of properties and securities, the examiner stated, Central realized inflationary profits of $22,851,692, half in operating companies and half in holding companies, as of December 31, 1930.

90,000 KW. TO BE NORRIS DAM CAPACITY



Tennessee Valley Authority, long exceedingly vague regarding the where and when and how much of the Clinch River project to immortalize the "father of Muscle Shoals" and make that development a practical power source by co-ordinated hydro operations, announces the plans for Norris Dam—two 45,000-kw. generators, completion in 1935 of the dam itself, and probable generation of energy early in 1936. The dam will create a lake 83 square miles in area with a shoreline between 800 and 900 miles in length. The design is notable for its simplicity. Construction started some weeks ago (ELECTRICAL WORLD, December 16, 1933, page 771) and is proceeding rapidly.

Coming Meetings

Oklahoma Utilities Association—Tulsa, Okla., March 6-7. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

American Society for Testing Materials—Washington, D. C., March 7. C. L. Warwick, 1315 Spruce Street, Philadelphia, Pa.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 19-20. N. R. Beagle, 101 W. High St., Jefferson City, Mo.

Electrochemical Society — Asheville, N. C., April 26-28. Colin G. Fink, Columbia University, New York.

Edison Electric Institute—Atlantic City, N. J., June 4-7. B. F. Weadock, 420 Lexington Ave., New York.

Taxes Important Factor in New Utility Legislation

As the state legislatures meet new laws further to regulate and tax utilities are submitted for consideration. Increased utility taxes appear to predominate in current plans.

Another attempt to help Ohio solve its taxation problem was made recently when a proposal to tax publicly owned utilities as privately owned ones are taxed was tentatively accepted by the special joint taxation committee as one of the tax measures that will be submitted to the Legislature. The proposal was submitted as a measure to help cities which own public utilities out of their financial difficulties by permitting them to use some of the income from the utilities for operating purposes.

Kentucky aid for municipals?

Indorsed by the Kentucky Utilities Consumers' League and the Kentucky Taxpayers' League, a bill to enable all Kentucky municipalities to acquire and operate utilities is being drawn for early introduction in the House The measure would permit municipalities to acquire by purchase or to lease or to construct and to hold and operate any light, heat, power or water plant within the municipal boundaries or within a 6-mile radius of the municipality. It would provide for local control of utilities rather than regulation by a state commission. The bill would make it mandatory for an election to be called in a municipality to determine the question of acquisition and operation of a utility service by a community upon presentation of a petition signed by 5 per cent or more of the voters. It also would authorize condemnation proceedings against a privately owned utility plant a community desired to acquire and operate.

Any municipality would be empowered, subject to the provisions of the act, to own, lease, erect, establish, purchase, condemn, construct, acquire, hold and operate any utility, without the consent or control of any department, bureau or commission other than the municipal council of the municipality in which the utility may be operated. The bill would provide for issuance of revenue bonds by a municipality to finance a utility project.

St. Louis tax shift?

With the purpose of equalizing the taxation of public utilities Mayor Dickmann of St. Louis has proposed a special tax of 5 per cent on the gross earnings of the Laclede Gas Light Company, the Laclede Electric Power & Light Company, the Mississippi River Fuel Corporation and the Western Union and Postal Telegraph companies. Regardless of the fact that the tax will be passed along to the consumers, he contends that taxation should be equable. The Union Electric Light & Power Company and the Southwestern Bell Telephone Company now pay the 5 per cent tax, the latter paying about $450,000 annually and the former $600,000.

It is evident from present indications that electric utilities will play an important part in the deliberations of the Canadian legislature this year. Premier Taschereau of Quebec is introducing a measure in the House aiming to authorize municipalities to take over electric services or to organize them on condition that they be administered by independent commissions which would fix rates so as to cover annual amortization and interest charges.

Virginia taxes proposed in the new revenue program include a merchants' license tax on utility companies, which will produce $85,000, and an increased franchise tax on utility companies, from which the state will realize $500,000. Protesting this burden on the utilities, Jack G. Holtzclaw, president of the Virginia Electric & Power Company, stated that if the new taxes are imposed by the General Assembly the company's tax bill will reach a figure which is 12.4 per cent of the total gross revenue of the company and 67 per cent of the net revenue after deducting operating expenses, bond interest, preferred stock dividends and retirements. He said the new taxes will cut the company's combined return on its properties to 3.4 per cent.

Seventeen bills, all aiming at removing the service charges by electric and gas companies, have been heard by the legislative power and light committee of the Massachusetts Assembly. Last year the Senate blocked passage of such a bill.

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7,500-Kw. Steam Generator

Installation of a 7,500-kw., 2,500-volt electric steam generator of the Penzold type, designed to carry the entire load of the Interlake Tissue Mills Company, Ltd., Merriton, Ont., has just been completed. The boiler shell has an inside diameter of 6 ft. and is 14 ft. high. There are three electrodes, each having two terminal connections, which pass through bushings in the top of the shell. These electrodes are thin cast-iron plates 31 in. high by 4 in. wide and bent at an angle of 120 deg.

Hydro Commission Warned of N.E.L.A. in Canada

That a unit of the erstwhile and quite extinct National Electric Light Association of the United States is secretly operating in Canada against the interests of the Ontario Hydro-Electric Power Commission was the astounding charge of C. Alfred Maguire, Hydro commissioner and president of the Ontario Municipal Electrical Association, at that association's recent Toronto meeting.

Quoting from the evidence of a United States Senate committee, Mr. Maguire pointed to evidence of Samuel Insull, as president of the N.E.L.A., attesting that his organization had twelve units in the United States and one in Canada with a "slush" fund of $1,500,000 a year. He warned that a propaganda organization working with private interests "is going on in our midst" and "we demand to know who represents this thirteenth unit of the N.E.L.A. in Canada." The N.E.L.A. ceased to exist in January, 1933. Mr. Insull, now a refugee from American justice in Greece, was president of the organization in 1898. Mr. Maguire's widely broadcast charges seem anachronistic, to say the least.

Coated Electrode Welding Enters Broader Fields

Improved quality welds resulting from using coated electrodes are rapidly increasing the variety of electric welding applications in industry. L. R. Leveen of the General Electric Company informed the Boston section of the American Welding Society at a meeting in Lynn last week that the United States Navy has practically excluded bare wire welding electrodes from its construction program. The American Petroleum Institute is co-operating with the American Society of Mechanical Engineers in establishing standards of electric welding practice for metal tanks and other vessels, and recently the leading steam railroads have begun to investigate the economic advantages of welding tank cars electrically instead of riveting. Pipe lines for oil systems and interior piping for buildings are coming into the field of electric welding; structural applications are increasing and heavy machinery is a well-estab-

lished field for this service. Ship construction is increasingly electrically welded, and the new naval program will rely upon this method extensively in the construction of destroyers, small tugs and airplane carriers, etc.

Tests show that steel members welded with coated electrodes had a tensile strength of 60,000 to 70,000 lb. per square inch, compared with 10,000 lb. less with bare electrodes. Ductility averaged 25 per cent, against 7 per cent, and corrosion was much less with coated electrode welds. At Schenectady and on the system of the Public Service Electric & Gas Company of New Jersey electric welding was essential to the successful manufacture of mercury-vapor units. At the former works seamless electric welding was so successful in a 14-in. steam pipe line half a mile long built for 400 lb. pressure and 750-deg. F. temperature that it was unnecessary to test it hydrostatically during installation, and no leaks were found when it was tested with steam pressure. Recently a 30-ton electric crane with all-welded frame was purchased. Mr. Leveen said that electric welding is gaining headway in steel bridge construction and maintenance, and in the latter the elimination of settling resulting from the removal of old rivets is a valuable advantage. Pipe lines for the Boulder Dam development are being electrically welded, and the automobile industry is showing an aroused interest in its possibilities and achievements in other fields.

P.W.A. Plans Budget; Protests Rise

CLOSED hearings are now being held before the Bureau of the Budget in Washington on the new public works budget under preparation. The Public Works Administration, Corps of Engineers and other government construction agencies have already submitted their estimates for new work in the next fiscal year. What amount P.W.A. is allowing for non-federal projects has not been determined. Funds would not become available until July 1, but the appropriation as of that date would permit allotments to continue on a contingent basis. It is expected that emphasis from now on will be put on federal projects, bearing particularly on flood control, navigation, power and the other beneficial uses of water. Since the entire $3,300,000,000 P.W.A. fund became exhausted, new allotments have been made possible through the rescinding of former grants for one reason or another.

P.W.A. aid protested

Many protests are being filed against the federal government's lending money to municipalities for electric light and power plants:

Protest has been lodged by the Washington Water Power Company with the state advisory board of the P.W.A. against the federal authorities lending any money to the city of Cœur d'Alene, Idaho, for municipal electric and water plants. The company protests that local conditions do not justify a loan, that the municipal plants would have to compete with the company's system and that the engineer's estimate of costs are too low.

Thirteen reasons why the town of Covington should not receive a loan and grant of $402,365 for the construction of a municipal electric plant were listed in a brief filed with the state public works advisory board by the Virginia Public Service Company, which is now serving the city. Among the reasons cited were that the company has a valid franchise not expiring until 1943; that the quality of the service rendered by the company has not been questioned nor the reasonableness of the rates attacked; that the company will be injured by the project and that the cost will be at least $400,000, which will duplicate a like existing investment by the company. Instructions not to permit public utility companies to delay unnecessarily applications of municipalities for loans and grants have been received by the Virginia public works engineer from Secretary of the Interior Ickes.

Governor Miller of Alabama has called upon the state Supreme Court for an advisory ruling as to the constitutionality of the Carmichael act passed by the last session of the Legislature permitting cities and towns to borrow money and buy or build electric light plants and transmission system. Applications of several Alabama cities for P.W.A. loans have been held up, causing Governor Miller to ask for an early opinion. Utilities questioned the constitutionality of the act at the time of its passage. Among the five grounds on which it is questioned is that as to whether a loan for a light plant may be properly classified as an indebtedness of the city and therefore necessary to come within the city's legal debt limit. Most Alabama municipalities, including some of those seeking loans, are already borrowed up to their constitutional limits.

Sutherland plan lags

Governor Bryan of Nebraska has received orders from Washington to withhold action upon the Sutherland public power district application until it can be determined if there will be sufficient water in the Platte River to supply both it and the tri-county project. Engineer Mickey, for the latter organization, has submitted figures to the Federal Power Commission which raise the question of the soundness of the Sutherland development. Governor Bryan is under fire from the public ownership groups in that state, particularly those interested in the various public power projects that have gained approval of appropriations of public funds, because of his delay in passing upon their applications for water rights. The Governor has wired Chairman McNinch of the commission that as Nebraska is without any body having regulatory and supervisory power with respect to rates and service, it will be necessary for the federal commission to fix rates. The Nebraska Railway Commission has authority only in disputes between rural customers and power companies. The Governor suggests that if the federal commission disclaims jurisdiction that Secretary Ickes cover rates in his mortgage agreement.

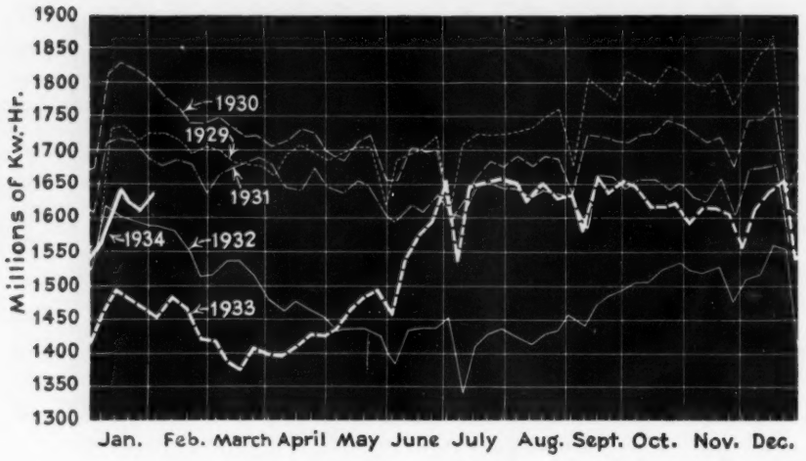
Important changes are being made in the design of the dam for the Grand Coulee project in central Washington, according to J. L. Savage, chief designing engineer for the U. S. Reclamation Service, who discussed the changes last week with members of the Washington State Columbia Basin Commission.

Wiring Allowances Planned to Spur Water Heating

Customers of the Boston Edison Company will be able to purchase electric water heaters from now on under more favorable terms. This utility has adopted a plan of free wiring and piping up to a $50 allowance on 40 and 60-gal. units. $53 on 80-gal. tanks and $55 on 100-gal. tanks and above. Costs exceeding these will be borne by the customer. The merchandising department has added twelve electric water heater and range salesmen to its staff and a vigorous cultivation of this class of load is under way. The company has had an off-peak water heating rate (restricted period 3 p.m. to 10 p.m. daily from October to April inclusive) in effect for nearly three years, but the cost of plumbing and wiring has retarded this development.

The rate carries an energy charge of 1 cent per kilowatt-hour for electricity consumed above the first 25 kw.-hr. per month, which is billed at 3 cents each. A $15 trade-in allowance has been established for old heaters of whatever type, and a three-year maximum term for completing payments has been set up, with a down payment of $10. Local contractors will be awarded installation jobs on the minimum bid basis. Installation requirements include the approval by the company of equipment sold by any other agency on the basis of its own specifications for manufacturers.

Output Rises Against Trend



During the week ended February 3 central stations for electric light and power generated 1,636,275,000 kw.-hr., according to the Edison Electric Institute. This is 1.6 per cent more than the preceding week's production; the gain over the corresponding week last year has risen to 12.5 per cent and compared with two years ago to 3 per cent.

The one-year increase is the largest since early autumn and the two-year increase the largest since the period prior to 1930. Both comparisons show contrast with the declines early in 1932 and 1933. Severe weather prevailing over much of the country during a part of the week may have contributed to the demand for energy, but heightened industrial activity is nevertheless indicated by the pronounced gains in manufacturing regions.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
Feb. 3...1,636	Feb. 4...1,455	Feb. 6...1,589
Jan. 27...1,611	Jan. 28...1,470	Jan. 30...1,589
Jan. 20...1,625	Jan. 21...1,484	Jan. 23...1,598
Jan. 13...1,646	Jan. 14...1,495	Jan. 16...1,602
Jan. 6...1,564	Jan. 7...1,426*	Jan. 9...1,619

*Slightly revised from data previously published.

Per Cent Change from Previous Year

Region	Week ended Feb. 3	Jan. 27	Jan. 20
New England	+11.8	+ 8.6	+10.0
Middle Atlantic	+12.3	+ 9.9	+ 9.3
Central Industrial	+16.6	+13.1	+13.0
West Central	+ 6.2	+ 5.2	+ 5.6
Southern States	+10.8	+ 7.9	+ 7.7
Rocky Mountain	+17.6	+17.5	+18.2
Pacific Coast	+ 8.6	+ 2.8	+ 2.0
United States	+12.5	+ 9.6	+ 9.5

State Department Denies Seaway Treaty Unfairness

Although attempts to obtain the Senate's unanimous consent to a final vote on the St. Lawrence treaty on February 10 failed last week, treaty proponents are predicting early ratification. The recent pressure brought to bear on the subject on the part of President Roosevelt (ELECTRICAL WORLD, February 3, page 206, and January 27, page 164) has caused the opposition to dwindle somewhat, but resistance is still being shown among Senators from states along the Mississippi and Missouri Rivers and the port cities of the Atlantic seaboard and the Gulf of Mexico.

Unfairness to the United States in the provisions of the treaty was denied by the State Department, which contradicted statements to the effect that Canada would contribute much less to its cost and derive far greater advantages from it than the United States. According to the announcement made by the State Department the cost has been balanced as absolutely as possible between the two countries, the United States paying $272,000,000 and Canada between $271,000,000 and $272,000,000. "The statement that Canada is to obtain 4,000,000 hp. and the United States 1,000,000 out of the whole St. Lawrence waterways development is true so far as it goes, but gives an incomplete picture," the statement says. "The fact is that the St. Lawrence treaty has been restricted to the international section of the waterway. The international section will develop 2,200,000 hp., of which Canada will get 1,100,000 and the United States 1,100,000. On the purely Canadian side of the river, Canada will be able ultimately to develop 3,000,000 hp. This development will be entirely at Canada's cost. . . ."

Indiana Utility Wins

In a decision handed down recently the Indiana Supreme Court has upheld condemnation of a strip of land near Gary, Ind., wanted by the Northern Indiana Public Service Company, Hammond, as right-of-way. The Supreme Court upheld the ruling of a Superior Court judge at Gary, Ind., in the original condemnation suits. The Supreme Court held the question involved was whether the land was to be used for general public benefit and it ruled it was.

Energy Output Up 4% in December, Says Survey

Output of electrical energy for public use in the United States in 1933 amounted to 85,259,000,000 kw.-hr., the Geological Survey announces. This is an increase of 2.5 per cent over the total production in 1932, and marks the first yearly gain since 1929. Production in 1930 was 1.5 per cent less, in 1931 4.4 per cent less and in 1932 9.4 per cent less than during the preceding year, in each case.

The increase began in May, which was the first month to show an excess over 1932. Gains continued during the remainder of the year, rising to 14 per cent in midsummer, then decreasing.

Production in December was 7,448,000,000 kw.-hr., or 4 per cent more than a year ago, but the daily average was 0.5 per cent less than in November, in contrast with a normal increase of 1 per cent.

The largest increase for the year's interval came in the Mountain region, 18 per cent. New England and the East North Central section gained 10 per cent, but the East South Central lost 6 per cent. Other regions show no great changes from 1932 figures.

Production of railway and various other types of plants generating energy for public use is included in the totals reported by the survey.

U. S. Bureau to Survey Western Power Projects

To determine the possibility of developing electric power at the Elephant Butte and Caballo dams, a survey will be made by the United States Reclamation Bureau in charge of R. F. Walter, chief engineer of the bureau in Denver. The El Paso irrigation district and Elephant Butte irrigation district will share the cost, which will cover all engineering features and prospective power markets.

Caballo Dam would have to be enlarged in design by the International Boundary Commission if the survey is favorable to the plan, but it is thought by reclamation officials that Elephant Butte Dam would need no alteration. Caballo is a $1,250,000 dam on Rio Grande above El Paso to impound 100,000 acre-feet and is part of the International Boundary Commission's Rio Grande control project. Elephant Butte Dam has a maximum head of 190 ft. and holds 2,600,000 acre-feet maximum; it was built in 1913.

As to Rates——

• Des Moines Electric Light Company will reduce its rates from 9 to 13 per cent, according to the provisions of a city ordinance passed by City Council. A reduction of 20 per cent also is effected in electricity furnished the city for street lighting. Altogether the saving to consumers and taxpayers will be $225,800. The saving to home consumers is approximately $187,200.

• Tennessee Electric Power Company has been authorized by the Tennessee Railroad and Public Utilities Commission to institute two new commercial rates, one of these being estimated to save customers $172,000. In addition, a promotional rate, which will be optional, is expected by the commission to effect large reductions.

• Georgia Power & Light Company rate schedules have again been ordered investigated by the Georgia Public Service Commission. The utility maintains that it purchases virtually all of its power from the Florida Power & Light Company at a fixed rate per kilowatt-hour under contract, making it almost impossible for it to reduce its charges any further, and that revenues for the company are already inadequate. The company recently submitted to a revision of its rates at the suggestion of the commission, with a saving to consumers of power amounting to approximately $14,000 a year.

• Arkansas Power & Light Company's electric light rates were the subject of a hearing before the Arkansas Corporation on a petition filed by citizens of Stuttgart for a reduction of approximately 20 per cent. Petition for reduction is based upon a valuation on the company's plant, which engineers from the W. A. Fuller Engineering Company recently appraised at approximately $129,000, compared with a valuation of $165,000 fixed by the company.

North Carolina inventory

• North Carolina Corporation Commission has ordered every public utility operating in North Carolina under its jurisdiction to file a detailed inventory of its property and assets so that the proper rate of return for each utility may be established. The inventories shall be as of December 31, 1933, and must be filed by April 1, 1934. The only commission figures now available purporting to give the value of utilities are the fixed capital accounts in the annual reports.

• Interstate Power Company's voluntary reductions in electric rates, effecting for residents of Dubuque, Iowa, a saving of $35,000 annually, have been approved by City Council.

• Public Service Company of Northern Illinois' recent rate hearings centered largely on estimates of 1934 earnings and on the relation of rates charged domestic consumers with average rates for such services throughout the state. Commission witnesses had introduced figures showing that the average rate paid by domestic consumers throughout the state was 5.3 cents per kilowatt-hour, against the company's average rate of 6.38 cents per unit. C. G. Bennett, engineer and vice-president of the company, testified that exclusion of the low rates in the Chicago territory of the Commonwealth Edison Company would leave the rates of the company under the average for the balance of the state.

• Telluride Power Company has been granted an order temporarily restraining the Utah Public Utilities Commission from penalizing the company for failure to put a 10 per cent rate reduction into effect. The commission is also restrained, pending a hearing on the power company's request for an interlocutory injunction, from interfering with the company in rendering bills and making collections from consumers on a basis of the rates which were in force prior to the commission's order (ELECTRICAL WORLD, December 23, page 811).

Free energy plan approved

• Southern Sierras Power Company's promotional rate plan, under which electric consumers would be given free kilowatt-hours ranging from 11 to 40 per cent as the amount of their bills increased, has been approved by the California Railroad Commission.

• Southern California Edison Company's agricultural power rates case, initiated on the application of the California State Grange for a downward revision and the elimination of the standby charge, has been adjourned by the California Railroad Commission until April 20.

• Indiana Public Service Commission's public counselor, Sherman Minton, in a statement recently issued, insisted that utilities must show cause why rates should not be reduced, declaring that "because formal rate hearings with tedious delays and costly appraisals have become a modern Frankenstein, I have tried to start something new in the way of obtaining reductions." He explained the procedure in recent cases in which utilities have been summoned to appear before the commission and show cause why there should not be a rate reduction.

• Indianapolis Power & Light Company, after demanding dismissal of the Public Service Commission's order instructing it to show cause why its rates should not be reduced, and after Perry McCart, chairman of the commission, said the company would be granted a hearing on its demand, in a surprise move during the argument offered a 5 per cent cut in electric rates, which the commission increased to 8 per cent.

• Westchester Lighting Company's rate agitation took more definite form last week when the Westchester Board of Supervisors petitioned the New York Public Service Commission immediately to institute and prosecute at its own expense a proceeding to bring about an immediate reduction in electrical rates and asked the state legislature to aid the commission by appropriating necessary funds.

Municipal Items

PITTSBURGH, PA.—City Council has passed an ordinance providing for a meter tax on electric, gas, steam and water companies, which will produce approximately $1,600,000 to aid the city in offsetting an unbalanced budget. The bill fixed a levy of $5 on each meter.

DANVILLE, VA.—Citizens will vote February 26 on the proposed power expansion program to decide whether an allocation made by the federal government on the loan and grant basis shall be availed of to develop a new municipal power plant at the Pinnacles, more than 60 miles from this city. City Council in adopting the ordinance providing for the issuance of revenue bonds to meet the costs of construction, slightly less than $2,500,000, petitioned the judge of the corporation court to set the referendum date.

AMHERST, OHIO.—Contract made by officials of the village of Amherst, Ohio, with Fairbanks, Morse & Company for the furnishing and installation of generating equipment for an electric light plant has been declared null and void in a recent decision by the Court of Common Pleas of Lorain County, which perpetually enjoined the municipal officials and the company from proceeding further under the contract. Suit was brought by a taxpayer who charged that the contract was obtained by fraud. Deciding in favor of the plaintiff in view of the evidence presented, the court ordered Fairbanks, Morse & Company to pay the costs of the proceeding. From the beginning attempts to build a municipal plant at Amherst have been stubbornly resisted. A Council ordinance authorizing the project was fought in the Common Pleas Court; decision in favor of the plant was carried to the Court of Appeals, where the lower court's holding was affirmed, and then plaintiff sought to prosecute error in the Supreme Court, where he again failed (ELECTRICAL WORLD, December 2, page 715).

FINANCIAL · · · BUSINESS

N.E.M.A. Code Statistics Insured Full Secrecy

Adequate safeguards by the National Electrical Manufacturers Association's statistical department to insure that "the statistics, data and information filed in accordance with the provisions" of the N.E.M.A. code "shall be confidential . . . and the statistics, data and information of one employer shall not be revealed to any other employer" are being taken.

Figures for individual firms can only be seen by NRA officials or for the purposes of code administration by authorized confidential representatives of the N.E.M.A. board of governors. At headquarters the N.E.M.A. statistical department is entirely separated from other portions of the organization. No one but the special employees of the department have access to it.

Patents Held Invalid; Lamp Makers to Appeal

Holding the patents on inside-frosted electric lamp bulbs to be invalid because of the "lack of patentability," Federal Judge Paul Jones of Cleveland this week decided against the General Electric Company and in favor of the Save Electric Company in a suit brought by General Electric charging infringement of its patent rights. Coming after recent charges and counter charges before the NRA (ELECTRICAL WORLD, January 6, page 58) the decision holds interest.

Previous to the decision of Judge Jones, Percy Taylor, special master, had held the patents valid. According to Hubert Howson, attorney for General Electric, the case will be taken to the United States Circuit Court of Appeals in Cincinnati. General Electric also filed suit against other independent manufacturers and distributors, but the other cases were settled out of court.

Attorneys for General Electric contended that if the patent rights were not upheld Japanese manufacturers would flood the domestic market with bulbs at ruinous prices.

GAINING

That momentary lull in the advance toward better business which crept into the figures and indexes available last week has disappeared. Progress has been resumed.

Energy production rose sharply from the previous week and is more than 12 per cent above last year. Automobile manufacture at 56,693 units a week, against 44,799 previously and 33,292 a year ago, shows makers to have solved new fabricating problems and to be meeting sales. Steel activity up from 34 to 36.5 per cent. Carloadings up 0.2 from previous week; 18.2 per cent over last year and 0.2 per cent over two years ago. Lumber orders from 10 to 27 per cent in excess of production. Bituminous coal output at about the levels of the previous week.

Prices of commodities were fairly strong. Securities turned weak in a technical trading offset of recent sharp gains.

Those $400,000,000 a month of government expenditures are setting a faster pace. Now is the time to capitalize on opening markets for products.

NRA Plans to Reopen All Codes

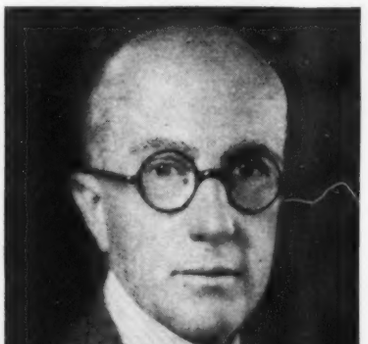
IN AN endeavor to clear up its two major problems, price fixing and labor protection, the National Recovery Administration plans to act upon them before all codes are reopened for later hearings. The labor question came into the foreground as a result of an exchange between the Iron and Steel Institute and the Administration over interpretation of President Roosevelt's recent executive order authorizing the National Labor Board to conduct employee elections whenever a substantial number of employees of any company shows a desire for a vote. With the American Federation of Labor planning a fight for a 30-hour week and Recovery Administrator Johnson conceding that a 32-hour week probably is necessary to reduce unemployment, the labor protective clauses of the recovery act are certain to have a large share of attention.

In addition to these two problems of price fixing and labor is the question of internal dissension. Rumors are circulating of shake-ups within the recovery administration. Friction between influential NRA officials drawn from industry and NRA employees with definite left wing inclinations is approaching a point where public accusations of unfairness are almost due.

Approval of the code of fair competition for the construction industry was given last week by President Roosevelt. Divisional chapters submitted by certain national associations, including the National Electrical Contractors Association, are under formulation by the NRA.

Sales restrictions seen

At the hearing on a proposed supplemental code for the refrigeration subdivision of the electrical manufacturing industry (ELECTRICAL WORLD, February 3, page 204) many changes of a clarifying nature were discussed. Irving C. Fox, representing the National Retail Dry Goods Association, objected to the wording of a number of articles in the proposed code because, he explained, it opened the way, either intentionally or inadvertently, for the manufacturer to follow the product into the retail trade and lay down rules for the sellers to the ultimate consumers. A major objection came from Philip D. Reed of the General Electric Company to the proposed "warranty and service policy." He told Assistant Deputy Administrator Cowling that his company considered the proposed replacement too high and as not applicable to its products, since replacements were rarely necessary and almost always could be made for less than the amounts suggested. Dr. William Schurz, the labor adviser suggested that because of the existence of peak periods in the refrigeration subdivision the code proponents consider maximum hours and minimum wages.



Without buyer confidence, no business moves beyond what is involved in satisfying the ordinary necessities of life. The hopeful thing ahead lies in the indication that crystallization of the changed rules of the game seems about at hand. Also a better apprecation is evidencing itself of what, both as to industry and as to government, the import and uses of the changed rules may be. If this hope is realized and converted into confidence, business upturn is assured and in substantial measure.

FRANK A. MERRICK,
President
Westinghouse Electric & Manufacturing Company

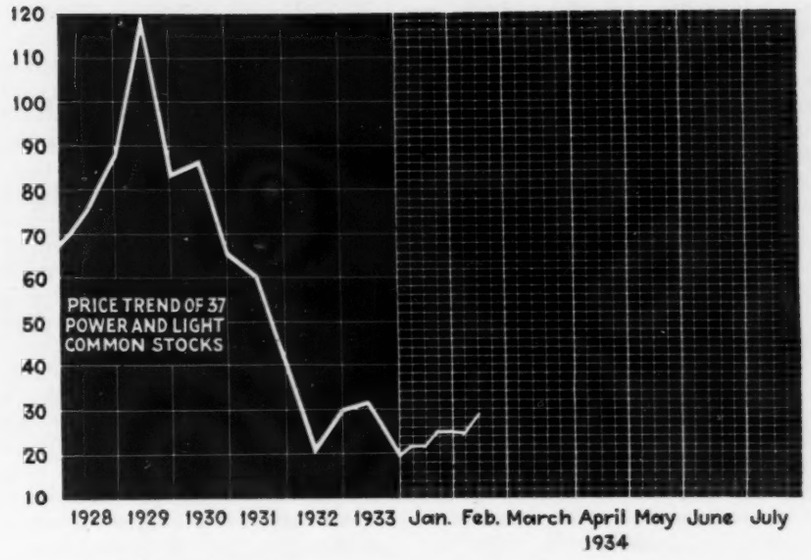
Commenting for the National Association of Manufacturers upon President Roosevelt's action to stabilize the dollar Mr. Merrick last week joined other business leaders in a hopeful estimate of the results.

Associated Wins One Case; Another Suit Amended

Receivership suit brought against the Associated Gas & Electric Company by Lindsey E. Bird (ELECTRICAL WORLD, November 25, page 678) has been dismissed by United States District Judge William Bondy on motion of the company, according to an announcement made by the company. The suit involved the question of violation of indentures and of the state law which prohibits a corporation from preferring creditors when the corporation is insolvent or in imminent danger of insolvency. Mr. Bird's petition estimated the company's liabilities at $509,000,000. Assets were at par at $694,843,704, with their fair value placed at not more than $300,000,000. Mr. Bird had represented himself to be acting in behalf of holders of $180,000 of debentures bearing 5 per cent interest and maturing in 1965.

Allegations that the Associated Gas & Electric Company, a New York Corporation, unlawfully transferred its controlling stock interests in subsidiaries of the Associated System to the Associated Gas & Electric Corporation, a Delaware corporation, are made in an amended bill of complaint filed in Chancery Court in Wilmington by Tessie Berwick of New York, holder of debentures of the New York corporation (ELECTRICAL WORLD, September 30, page 423). The court is asked to enjoin issuance of any bonds or debentures in connection with the recapitalization plan for the New York corporation and to enjoin expenditures of any more funds in enlisted support of the plan. The court is asked to compel transfer of the assets back to the New York corporation.

Utility Stocks Continue Gains



Speculative operations this week rallied public utility issues, as other stocks met selling pressure. "Electrical World" index advanced from 25.0 last week to 29.0 this week, the highest point recorded since the end of July.

Appalachian Electric Upheld

Attorney-General John R. Saunders of Virginia has filed in the Supreme Court of the United States a brief supporting the Appalachian Electric Power Company in its challenge of the authority of the Federal Power Commission over hydro-electric developments on non-navigable streams. The Attorney-General insists that the State of Virginia has control over such waters which includes the proposed power development of the company on the New River, in Pulaski County, Virginia, under the federal constitution, and therefore has full control in regulating operations.

Current Earnings Reports of Electric Light and Power Companies

Operating Companies

	1933	1932	Per Cent Increase	Operating Ratio 1933	Operating Ratio 1932
Alabama Power (Year ended December 31)					
Gross earnings	$15,486,234	$15,583,839	— 0.6	49	48
Net earnings	7,970,718	8,084,089	— 1.4		
Net balance	933,967	1,114,516	— 16.2		
Consumers Power (Year ended December 31)					
Gross earnings	25,911,451	27,931,248	— 7.2	51	52
Net earnings	11,539,793	13,439,271	— 14.1		
Net balance	2,799,377	4,776,210	— 41.2		
Detroit Edison (Year ended December 31)					
Gross earnings	41,359,064	44,023,080	— 6.0	69	71
Net earnings	12,701,991	12,786,909	— 0.7		
Net balance	6,146,369	6,633,103	— 7.3		
Georgia Power (Year ended December 31)					
Gross earnings	22,159,789	22,416,127	— 1.1	49	49
Net earnings	11,172,563	11,515,203	— 2.9		
Net balance¶	2,115,124	2,326,279	— 9.1		
Oklahoma Gas & Electric (Year ended November 30)					
Gross earnings	$10,450,190	$11,018,094	— 5.2	60	60
Net earnings	4,142,600	4,488,972	— 7.7		
Net balance	1,741,199	2,093,784	— 16.8		
Puget Sound Power & Light (Year ended November 30)					
Gross earnings	12,591,680	13,727,563	— 0.9	65	60
Net earnings	4,508,319	5,421,180	— 16.8		
Net balance	1,129,763*	487,381	—331.0		
Tennessee Electric Power (Year ended December 31)					
Gross earnings	11,410,158	11,743,675	— 2.8	60	57
Net earnings	4,603,374	5,019,059	— 8.3		
Net balance	391,571	819,366	— 52.2		

Holding Companies

	1933	1932	Per Cent Increase	Operating Ratio 1933	Operating Ratio 1932
American Gas & Electric and subsidiaries (Year ended November 30)					
Gross earnings	$63,330,753	$65,693,834	— 3.6	54	51
Net balance	7,601,249	10,150,945	— 25.0		
American Power & Light and subsidiaries (Year ended November 30)					
Gross earnings	73,200,364	76,309,997	— 4.1	57	52
Net balance†	4,680,849	9,358,774	— 50.0		
Commonwealth & Southern and subsidiaries (Year ended December 31)					
Gross earnings	109,043,013	114,513,921	— 4.8	55	54
Net balance	499,359*	4,247,694	—111.8		
Electric Power & Light and subsidiaries (Year ended November 30)					
Gross earnings	68,296,055	74,133,774	— 7.9	64	58
Net balance†	1,276,924*	5,327,420	—124.0		
Engineers Public Service and constituent cos. (Year ended November 30)					
Gross earnings	42,472,129	46,731,515	— 9.1	65	65
Net balance	579,630*	2,109,596	—128.0		
National Power & Light and subsidiaries (Year ended November 30)					
Gross earnings	68,564,279	71,943,734	— 4.7	60	63
Net balance†	6,782,194	8,829,350	— 23.2		
Public Service Corporation of N. J. and subsidiaries (Year ended December 31)‡					
Gross earnings	116,672,436	125,833,707	— 7.3	65	66
Net balance	26,375,236	28,289,378	— 6.8		

*Deficit. †Before all dividends. ‡Preliminary. ¶After 1st preferred.

Gross earnings—(Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net earnings—Earnings after deduction from gross earnings of operating expenses taken to include taxes, depreciation, maintenance, operating, etc. Net balance—Balance available from income for common stock dividends.

Allis-Chalmers Orders Up $1,954,384 in 1933

In a preliminary report for 1933, just issued, the Allis-Chalmers Manufacturing Company reports orders booked amounting to $14,270,940, as compared with $12,316,555 for the previous year, and unfilled orders on December 31 totaling $6,425,998, against $5,441,825 at the close of 1932. Billings for the year totaled $13,286,767, against $14,764,063.

Operating loss of the company was $1,462,694, against $1,353,326 in 1932; total loss after provision for debenture interest, depreciation, $270,000 year-end adjustments and other charges was $2,893,905, against $2,955,042 loss in 1932. Balance sheet shows net current assets of $23,454,642, compared with $25,231,416 a year earlier; cash and marketable securities, $6,340,355 on December 31, 1933, against $5,168,020 at the end of 1932.

Crocker-Wheeler Sales Up

During 1933 sales of the Crocker-Wheeler Electric Manufacturing Company rose 51 per cent, or $311,287, over 1932, according to Edmund Lang, president. For the same time bookings were up 62 per cent, export business was more than doubled, and the net loss of the corporation after depreciation, interest and charges fell from $429,278 to $123,531. Operations for three months in the second half were at a small profit.

G. E. Makes Gas Furnaces

Supplementing the line of oil-burning furnaces which it placed on the market about a year ago, General Electric announces entrance into the gas furnace field. The offering consists of a coordinated unit consisting of burner boiler, control and all parts inclosed in a single jacket of distinctive appearance.

$500,000 Appliance Order

Orders in excess of $500,000 for 1,000 electric ranges and 2,500 refrigerators have been placed with the Westinghouse Electric & Manufacturing Company by the Interstate Power Company, which, with the Central Light & Power Company and the Central States Power & Light Corporation, has just embarked on an intensive four-year program of merchandising electrical equipment to increase current consumption.

New York Metal Prices

	Jan. 30, 1934 Cents per Pound	Feb. 6, 1934 Cents per Pound
Copper, electrolytic	8.25	8.00
Lead, Am. S. & R. price	4.00	4.00
Antimony	7.15	7.15
Nickel ingot	35.00	35.00
Zinc, spot	4.60	4.75
Tin, Straits	51.50	50.75
Aluminum, 99 per cent.	23.30	23.30

C.W.A. and Research

Under the direction of Dr. J. B. Whitehead, three C.W.A. workers have for several weeks been investigating high-voltage cable insulation at Johns Hopkins laboratories as a continuation of Dr. Whitehead's recent work on the relation of the inherent electrical and capillary properties of the oil and paper to the life of the impregnated product. These three C.W.A. men have been authorized for the project as part of a total C.W.A. group of seven. Dr. Whitehead's investigations already reported have indicated certain definite co-ordinations of the type suggested, and the present project is largely an extension of the same type of studies to certain groups of insulating oils not previously investigated.

Black & Decker Sales Up

For the quarter ended December 31 the Black & Decker Manufacturing Company reports net sales of $525,297, an increase of 56 per cent over same period of the previous year. S. Duncan Black, president, stated that December sales were 67 per cent above the year before. He added that the improvement is still under way and that sales during January had exceeded those for the corresponding month last year by 90 per cent.

Cookeville Powerless

No municipal power for ten days or longer was the prospect facing Cookeville, Tenn., last week, after a tower supporting a flume broke at the hydro-electric plant at Burgess Falls. Meanwhile, local industry came to a standstill while efforts were made by the city to have lines from the Tennessee Electric Power Company tied onto local lines during the emergency.

Chicago to Have Large Sign

Under construction in Chicago is a large display sign requiring 17,240 sockets, 1,100 ft. of neon tubing, 21 miles of wire and cable and having a connected load of 445 kw. It is being built by the Federal Electric Company of Chicago over the Michigan Central tracks and overlooks Grant Park, facing south. The display proper is 158 ft. long by 148 ft. high; the bottom is 140 ft. from the ground line, so the top is 288 ft. above ground. It contains 330 tons of fabricated steel and has a permanent elevator to the penthouse control room. The Chevrolet display trademark is in 14-ft. letters, and in addition there is a 50-ft. Telechron clock, a 13-ft. motograph and revolving and color changing background.

Major New Construction This Week

Heavy-duty motors, controls, transformers, electric pumping machinery, conveyors, etc., will be installed in Texas City, Tex., plant of Sun Oil Company, at a cost over $500,000.

Mississippi Valley Public Service Company, Winona, Minn., plans extensons in transmission lines at Trempealeau, Wis., and vicinity.

Cuban-American Distilleries, Inc., New Orleans, La., to build plant at cost of about $125,000.

Iowa City, Iowa, has called special election April 17 to approve bonds for $917,000 for new city-owned electric light and power plant.

Elkforge Distillery Corporation, Elk Mills, Md., plans $100,000 expansion.

Northern States Power Company, Minneapolis, Minn., has authorized improvements in power plant at Sioux Falls, S. D., including installation of new 1,000-hp. boiler unit and other equipment. Cost about $125,000.

Aztec Brewing Company, San Diego, Calif., plans $300,000 addition.

Hastings, Neb., soon will ask bids for equipment for extensions and improvements in city-owned electric light and power plant. Fund of $157,912 available.

Yuma, Ariz., plans city-owned light and power distribution system.

Holly Hills Distillery, Holly, Mich., plans alterations and improvements for new distillery. Cost about $175,000.

Electrical Show in Fall

With the purpose of duplicating, if not outdoing, its achievement last year, the Electrical Association of New York, Inc., will again sponsor a national electrical exposition to be held at Madison Square Garden from September 19 to 29 inclusive. The exposition will include radio, refrigeration, air conditioning and home and industrial appliances.

A.S.T.M. Specifications

Tentative specifications of the American Society for Testing Materials for flexible varnished tubing used in electrical insulation, methods of testing sheet and tape electrical insulation for thickness, black bias-cut varnished cloth tape used for electrical insulation, insulated wire and cable and performance of rubber compounds and insulated wire and cable have been announced.

MEN OF THE INDUSTRY

H. MORRIS KELLEY, president of the Essex Trust Company, Lynn, Mass., was elected president of the Lynn Gas & Electric Company January 30 to succeed the late Micajah P. Clough.

A. G. PRATT, president of the Babcock & Wilcox Company, has been elected to the board of directors of the Worthington Pump & Machinery Corporation. Mr. Pratt is also a director of the Babcock & Wilcox Company and of various other industrial enterprises.

H. LESTER HOOKER, member of the Virginia State Corporation Commission, became chairman of that regulatory body last week, following the custom whereby this office rotates annually among the members of the commission.

LINWOOD KIGHT, formerly promotional manager of the Potomac Edison Company, has been appointed merchandise manager of that company. S. S. BRADFORD has been assigned to Mr. Kight's former position.

ROBERT H. PATTERSON has been appointed vice-president and manager of the Lawrence (Mass.) Gas & Electric Company, succeeding Horace G. Taylor, who has been transferred to the Arlington Gas Light Company as manager in place of Mr. Patterson. Both properties are under the management of the New England Power Engineering & Service Corporation.

HENRY A. MORSS, treasurer of the Simplex Wire & Cable Company, Cambridge, Mass., has been appointed acting treasurer of the Massachusetts Institute of Technology. He has been a life member of the corporation since 1924 and assistant treasurer for many years. Dr. VANNEVAR BUSH, vice-president of the institute and dean of engineering, has been appointed assistant treasurer.

D. S. YOUNGHOLM, who has been associated with the Westinghouse Lamp Company for the past 25 years, was elected a vice-president of that organization last week, with headquarters in New York. His first position was in the engineering department, checking formulas and specifications. Later he was transferred to the stock and statistical departments, after which he entered the sales department. In 1924 he was placed in charge of production, making his headquarters at Bloomfield, and a year later he became assistant manager of sales. In 1927 he was made assistant general superintendent of the company and after three years became assistant to vice-president, the position he held until his recent election. During his service in the company his headquarters at various times have been in Kansas City, Chicago, St. Louis, Bloomfield, N. J., and New York.

A. E. Allen New Executive of Westinghouse Electric

Arthur E. Allen, who was elected vice-president of the Westinghouse Electric & Manufacturing Company in charge of the merchandising division (ELECTRICAL WORLD, February 3, page 204), entered the employ of Westinghouse Electric in 1902, at the Newark Works, and was in charge of the test department there

until 1910. In that year Mr. Allen was loaned to the International Electric Protection Company to act as its chief engineer, and upon the completion of this work he returned to the Westinghouse supply department of the New York office in 1911, and in 1915 was made manager.

After discharge from military service during the World War, Mr. Allen returned to the New York office in February, 1919, as executive assistant to the manager of the New York office. That same year he was promoted to manager, and in 1925 he was made general manager of the Westinghouse Lamp company, and the following year he was elected vice-president of that company, the position he occupied until his recent election. He is a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers and of other associations.

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NEIL A. CLARK has been appointed district manager of a newly formed north central district of the New England Power Association properties with headquarters at Leominster, Mass. The electric utilities under his jurisdiction include the companies serving the following areas: Leominster, Gardner, Clinton, Athol and Orange, Winchendon, Ayer and Harvard, Mass. Mr. Clark has recently been manager of the Quincy (Mass.) Electric Light & Power Company, and assistant general manager of the Narragansett Electric Company, Providence, R. I. Still earlier he was manager of the Fall Mountain Electric Company, Bellows Falls, Vt., where he joined the New England Power company system in 1921 as station foreman.

CLAUDE D. LAWRENCE has been appointed assistant sales manager of the New England Power Engineering & Service Corporation, with headquarters at Boston. Mr. Lawrence is well known in New England power sales circles, having joined the New England Power Company system in 1929 as personal assistant to Hugo Rocktashel, sales manager. Previouly he was connected with the Scranton (Pa.) Electric Company and the power sales department of the Central Hudson Gas & Electric Company, Poughkeepsie, N. Y. He has been actively concerned with industrial load building problems in the retail companies of the New England system as well as in the wholesale power properties.

ARTHUR F. HEARL, prominently identified with the electrical contracting industry, was appointed secretary of the National Electrical Contractors Association at the midwinter meeting of the board of managers held recently in New York. Mr. Hearl has had long experience as a credit executive. For years he was credit manager, treasurer and later president of the American Electrical Supply Company, Chicago, and for the past year has been identified with the Metropolitan Electrical Supply Company, also of Chicago. For many years he has given generously of his time to the contractors' association. For several terms he served as a member of the executive committee of the central division, was president of that division from 1927 to 1929 and was president of the national association during 1931-32. He has been since 1924 and is now a member of the National Board. For the present Mr. Hearl will give part time to the Metropolitan Electrical Supply Company, at the same time taking on this new work.

OBITUARY

JOHN C. CARROLL, auditor of the New York Edison Company and the United Electric Light & Power Company, died January 30 at his home in Richmond Hill, L. I., of influenza, after a brief illness. Mr. Carroll had been identified with the United Electric Light & Power Company since 1899, when he entered its employ as a bookkeeper. In the suc-

ceeding 34 years he rose through various grades and positions, becoming accountant in 1923, general accountant in 1925, assistant secretary in 1927, and treasurer in February, 1932, which position he held until February 7, 1933, when he was made auditor of both the United and Edison companies. Mr. Carroll was 60 years of age.

HORACE T. SHARP, industrial manager of the Southern Indiana Gas & Electric Company, Evansville, died recently at his home in that city. He was 55 years old.

WILLIAM J. BUTLER, until recently an electrical designing engineer on the factory staff of the B. F. Sturtevant Company, Hyde Park, Mass., died at his home in Brockton, January 31.

FRANK W. KENNEDY, vice-president and general manager of the De Laval Steam Turbine Company, Trenton, N. J., died January 24, at the age of 58. Mr. Kennedy was a director of the First Mechanics National Bank, vice-president of the Wilbur Trust Company and president of the American Bauer-Wach Corporation.

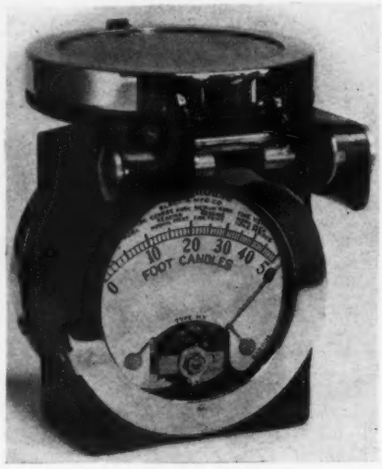
WILLIAM H. HAMMOND, 68 years old, for 43 years connected with the Louisville Gas & Electric Company, died December 20 at his home. A sufferer of heart disease for two years, he was stricken seriously ill a month ago. Born on a farm in Oldham County, Mr. Hammond came to Louisville when a young man and became connected with the Kentucky Heating Company in 1889. For 30 years he had been foreman of the gas meter department of the Louisville Gas & Electric Company and developed a system of recording locations of meters that gained for him wide recognition.

SYDNEY O. SWENSON, engineer, died suddenly February 1, at his home in Garden City, Long Island, in his sixtieth year. A native of Chicago, and a graduate of the University of Illinois, Mr. Swenson spent more than five years with the Commonwealth Edison Company, engaging in work on power plants, substations and underground conduit systems. Subsequently he became identified with the electrification of the New York Central Railroad at New York and later engaged in similar work for the Michigan Central Railroad at Detroit. In the course of his career he was connected with Ford, Bacon & Davis, consulting engineers of New York, and with the J. G. White Engineering Corporation, also in New York. Later he was affiliated with the Electric Bond & Share Company for nine years, where he engaged in miscellaneous engineering problems, including appraisals on properties, distribution systems, and high-tension transmission lines.

NEW EQUIPMENT

Light Meter Improved

For measuring light intensities and making illumination surveys the Westinghouse Electric & Manufacturing Company has announced the "Right Light" meter, sturdy and compact for pocket use. Only a few seconds is needed to check lighting conditions at



any point, for the dial, which has a 1.8 in. scale and 50 divisions, is calibrated directly in foot-candles with zones denoting the minimum amount of light needed for specific types of work.

The cell is the new Westinghouse "Photox" cell, a photo-voltaic cell of disks of copper and copper oxide which gives sufficient current under light without auxiliary electrical supply and is aged and treated to stand long use without service-aging or necessity of changing calibration. The microammeter is designed to withstand severe portable service. A hinged cover improves compactness and ease and accuracy of readings.

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AUTOMATIC ELECTRIC WATER HEATERS with monel metal tanks are announced by the Hewitt Electric & Manufacturing Company, Arlington, Mass., in 30-, 50- and 60-gal. sizes. The tanks are unaffected by water conditions and are stronger than galvanized iron or copper construction by 25 to 50 per cent.

SOLENOID-TYPE STARTING SWITCHES for across-the-line starting, that are compact and reliable, have been introduced by the Allen-Bradley Company of Milwaukee, Wis., as Bulletin No. 709, to replace its clapper type design. These are available for two-phase and three-phase service with maximum ratings of 3 hp., 110 volts; 5 hp., 220 volts, and 7½ hp., 440-550 volts. Three forms, according to use and control desired, may be had. The units are small, self-insulated, with all wiring inside so they can be mounted directly on machine frames or in metal cabinets; double-break silver contacts of silver alloy, which last longer, with no maintenance are used; switches are rubber-mounted to the base plate to prevent the transmission of vibration which might damage contacts or be carried to starter cabinet.

DIELECTRIC STRENGTH TEST SETS for measuring the insulation value of sheet materials or complete units are offered by the Sound Engineering Corporation, Chicago, Ill. The secondary voltage delivered is 10,000 as a maximum and the output voltmeter is calibrated in three ranges—0-1,000 volts, 0-5,000 volts and 0-10,000 volts. This set operates at 60 cycles, 110 or 220 volts. It is mounted in a metal case 16x18½x8¼ in. and weighs 65 lb.

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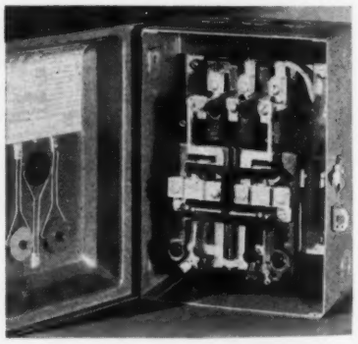
Solenoid-Type Starters

Automatic motor starters of the solenoid type are announced by the Square D Company, Industrial Controller Division, Milwaukee. The contactor has a vertical, straight line, solenoid action and cannot be accidentally closed by vibration; flexible leads have been entirely eliminated; the thermal overload relays are mounted on the front of the panel



and are easily interchangeable; extra wiring space is provided in the cabinet and the push buttons on the cover are extra large, 1 in. diameter; contacts are silver, double break and give high current rupturing capacity; insulating base and arc barriers are porcelain, which does not carbonize nor readily collect dust. This starter is designated Class 8532, type F and has maximum polyphase ratings of 5 hp., 220 volts; 7½ hp., 440-550 volts. It is also built with four-pole contactor for two-phase service.